EDITORIAL

OUR local Board of Supervisors during the past few months has declared war on the British Empire over the Irish question, and on the Federal Courts because of the coal-strike injunction. Who will be the next to feel the lightnings of their displeasure?

SHIPBUILDING statistics for the twelve months ended October 31, or practically the year following the signing of the armistice, have recently been announced. The total gross tonnage of sea-going vessels completed at American yards was 4,128,430, of which 3,359,888 tons was for steel and 768,542 tons was for wooden ships. Since April the output of steel ships has been fairly uniform, ranging from 300,000 to 400,000 tons per month. On the other hand, the construction of wooden ships is being rapidly wound up, only 28,944 tons being completed in October.

RADICALS of various kinds, including some representatives of organized labor, recently held a convention at Chicago to form a 'Labor Party of the United States'. The new party expects to enter the Presidential campaign next year. The general character of the convention is indicated by some of the resolutions adopted, which called for the impeachment of Judge A. B. Anderson because of his action in granting the injunction in the coal-strike case, for the release of Debs and other 'political and industrial prisoners', and for a new trial for Mooney and Billings.

COMPULSORY investigation of labor disputes rather than compulsory arbitration is probably the most important recommendation of the United States Senate committee after its study of the steel strike. This is now the law in Canada, and, while it does not eliminate labor troubles, it helps materially in that direction. In brief, the plan would provide for an investigation by governmental authority of labor disputes affecting any public utility or industry of vital public interest, pending which investigation a strike or lockout should not be called. At the completion of the investigation, a full report would be made, telling what should be done, but with no authority but that of public opinion to enforce the recommendations. It is an interesting plan, and deserves a fair trial.

FINAL figures regarding subscriptions for all five Liberty Loans for the Twelfth Federal Reserve District, which includes Alaska, California, Hawaii, Idaho, Nevada, Oregon, Utah, Washington, and part of Arizona, have recently been issued. These show that each State and Territory exceeded its quota for every drive. The total of all quotas was $1,263,500,000, and the total subscribed was $1,535,216,650. The largest number of subscribers for any one loan was 2,123,063 for the Fourth Loan. The total number of subscriptions was 5,495,524. Allowing for duplication and for the number that have, through necessity or choice, sold their bonds since the drives, it is probable that there are still at least 2,000,000 holders of Government securities in the District, out of a total population of 5,304,159 according to the census of 1910. There is not much encouragement for the Bolshevist in these figures.

FAILURE of the steel strike becomes more and more certain. The statistics of pig-iron output for October, as was to be expected, showed a material reduction in operations, the production being 1,978,218 tons compared with 2,480,790 tons in September, 2,742,081 tons in August, and 3,482,392 tons in October 1918, when war work was at its height. However, while over 100 stacks were blown out during the first week of the strike, leaving only 163 in blast on September 30, 54 stacks were blown in again during October, and there seems to be good reason to believe that November will show production comparing favorably with the records of the summer months. The return to normal conditions has not been so rapid in the steel-mills as it has been among the blast-furnaces, but improvement is general in all the districts affected. The coal strike has thus far had little influence on operations, which is largely explained by the fact that the mines and ovens of the principal coke-producing regions have not been affected.

A NEW industrial conference meets in Washington at the call of the President on December 1. There are no representatives of either Capital or Labor, the personnel of the conference corresponding more nearly to that of the public group in the former conference, although none of the old public group are members of the new conference. All the members of the new conference have been appointed directly by the President. They are Messrs. W. B. Wilson, Secretary of Labor; T. W. Gregory and G. W. Wickersham, former United States Attorney-Generals; Herbert Hoover; Oscar S. Straus, former Secretary of Commerce; H. M. Robinson, formerly of the United States Shipping Board; F. W. Taussig, formerly chairman of the Tariff Commission; S. W. McCall, M. H. Glynn, and H. C. Stuart, former State Governors; W. O. Thompson, of Ohio State University; Richard Hooker, Springfield, Massachusetts; George T. Slade, St. Paul; Julius Rosenwald, Chicago; O. D. Young, New York; Stanley King, Boston; and H. J. Waters, Manhattan, Kansas.

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No Peace Yet

Germans on the other side of the Atlantic, and pro-Germans in this country were much pleased when the United States Senate adjourned without ratifying the Treaty. Most of the rest of us were not. What will happen at the session just opened cannot be foreseen. Perhaps an agreement can be reached, as it is evident that more than two-thirds of the Senators wish to see the Treaty ratified. Perhaps the whole question must be postponed until after the coming Presidential campaign, which will necessarily make the League of Nations the main issue. While President Wilson has been at fault because of his lack of tact and his compromising attitude during the past year, the principal blame for the present situation must fall upon those Senators who, for political reasons, forced the adoption of reservations declaring virtually that the United States would accept any benefits accruing from the League of Nations but would not assume any of the corresponding obligations.

Turning Over a New Leaf

It is interesting to learn from a Government announcement that the Bureau of the Census intends next year to break precedent and get some real information in its census of manufacturing establishments, although the statement is not sufficiently definite to enable the reader to determine whether the Bureau will really obtain much worth-while information or not. Those of us who took part in the 'Preparedness Census' taken under the direction of the Naval Consulting Board the year before the United States entered the War, were impressed by the fact that the information obtained was the kind that should have been gathered regularly by the Bureau of the Census and have been on file at Washington all the time. We would suggest that the Bureau take the schedule-blanks prepared at that time as a basis for its work. In addition, measures should be taken toward keeping this information up-to-date during the period between one census and another.

Wanted—An Organization

On December 10, a meeting will be held at the Palace Hotel, at which Mr. George W. Cartwright, former State Senator, will speak, and at which the formation in San Francisco of such an organization as the Commercial Federation of Los Angeles will be discussed. The Los Angeles organization is a federation of some 50 or 60 commercial bodies, including the Chamber of Commerce, the Merchants' and Manufacturers' Association, and the Founders' and Employers' Association. By handling questions of importance to the welfare of the city as a unit, better results are obtained than if each association was working alone. A similar organization of the business interests of San Francisco would be the greatest influence in the business life of the city. Such a body could not be ignored by either newspapers or politicians and would have an influence in civic affairs that would be effective. The disadvantages of the present lack of organization are illustrated by the shipyard and metal trades strike. This struggle is not a matter of a few cents in wages or of broken contracts; the underlying question is whether San Francisco shall become a manufacturing centre or whether it shall sink back into the slough from which it emerged when the non-competitive war business revived the industries in this region. In this struggle many of the business organizations, though really vitally affected, are not alive to the necessity of taking part. Never before in the history of the city has there been such an opportunity to put over a thing that means as much to the prosperity of the city as the open shop does at this time. The metal trades employers, who are fighting for their very existence, should not be forced to make this fight alone while the other business men of the city stand by idly, ready to reap any benefit, but taking none of the risk.

The Open Shop

The members of the California Metal Trades Association and the California Foundrymen's Association have started something. Can they finish it? We believe they can, provided certain conditions, some of which are not entirely within their control, are fulfilled.

First of these is the all-important requirement in any struggle, that of standing together. There is no need to quote specific instances to prove that in the Bay district in the past, employers in all industries, including the metal trades, have shown far less solidarity than employees. And this standing together means more than simply the observance of the new shop conditions. It means that the larger and stronger firms must be ready to help to finance the smaller and weaker ones if this becomes necessary. It means, furthermore, that support, moral and, if necessary, financial, must be available from all the business associations of the District. None of them are really satisfied with closed-shop conditions. Why should they pretend that they are, or hang back from a movement to remedy them?

We have said that the Associations have a struggle on their hands, but we do not wish to imply that it is a struggle with Labor as such, or even with trade unions as such. It is not, but it is a struggle to the death with certain practices that have grown up in connection with trade unions, and which are as detrimental to the employee and to the public as to the employer. Such practices were largely responsible for the depression in the metal trades during the years immediately preceding the War. The fortuitous prosperity of the War period, when competition in price was unnecessary, has come and gone. Efficient production is now a prerequisite for competition with other districts, and to obtain efficient production under closed-shop conditions appears

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to be impossible. The interests of not only employers and employees in the metal trades, but also those in other industries, and, in fact, of the entire population, demand that the metal trades instead of going back to old repair-shop days, go forward and place the San Francisco Bay district where it belongs.

Square Deal for the Miners

Our natural revulsion from the extravagance of the coal-miners' demands and from the piratical methods used in attempting to enforce them should not blind us to the fact that the real underlying cause of the coal strike was the incompetence and stupid conservatism of the employers in the coal industry. We have before us a statement by the United States Bureau of Mines issued since the strike was called showing the average number of hours worked per week for the bituminous-coal mines for every week from the signing of the armistice until October 25. The greatest number is 39.7, the least 22.7, and the average 30, exactly the weekly scale asked by the strikers. It might be urged that the year just past has been an exceptional one, but statistics covering several years show that few miners can get more than 225 days work per year, that work in the summer at most mines is particularly uncertain, and, perhaps worst of all, a man seldom knows on Saturday night whether or not car shortage may deprive him of one or more days' work during the week following. The operators have tried to 'pass the buck' by pointing out that while the average number of possible days of work has been around 225, the average number of days worked by the individual miner has been about 169. To this there are at least two obvious replies. One is that uncertainty of employment breeds uncertainty of men, and the other is that it is highly probable that many men are obliged to supplement their wages by other employment, and that this employment frequently keeps them from work at the mines. Outside of a few open-cut mines, weather conditions have nothing to do with coal-mining, and the year's demand for the entire country can be predicted within comparatively narrow limits. No reason whatsoever exists for coal-mining to be a seasonal industry. There is no use to try to 'pass the buck' to the consumer by saying, what is perfectly true, that he ought to buy more coal in the summer time. How long would the natural-ice industry survive if ice was cut only when there was a demand for it? Nor is it feasible for the operators to clear themselves by a general curse on the railroads for failing to supply cars. Other industries provide storage for just those conditions. In short, the practice in the past has been to place a large part at least of the burden of uncertainties of demand and transportation upon the miner, instead of upon the consuming public, where it belongs. The operators must provide storage at the mines and elsewhere so that they can work their properties on approximately a 300-day per year basis, and they must find means to finance the building of this storage and also of carrying the stored coal over the periods of slack demand. This is not going to be easy, but it can and must be done. It may and probably will increase the cost of coal to the consumer, but it will not increase it nearly as much as paying the miner enough for the days he now works to constitute a living wage for the entire year, which is the only other just course. Whether the operators realize it or not, private ownership in every industry is on trial at the present time. We believe that it will vindicate itself, but it can do so only by proving itself to be more competent than public ownership. If the coal industry continues to be run as incompetently and as cruelly as it has been in the past, nationalization of the mines is only a question of time. There is as little room in this country for Bourbonism among employers as there is for Bourbonism among employees.

Training for Industrial Cripples

Bills providing Federal aid for the vocational training and rehabilitation of persons disabled by industrial accidents have passed both Houses of Congress. At the time of going to press, no definite information was available as to whether or not the slight differences in form between the measures passed by the Senate and the House had been adjusted, and the conference measure made ready for the President's signature. However, if this has not already been done, it is reasonable to suppose that it will be arranged at the next session. The main provisions of both bills are identical. An appropriation of $500,000 is made during the fiscal year ending June 30, 1921; $750,000 during the year following, and $1,000,000 during each year thereafter. The amount expended in each State must be met by an appropriation of at least as much from State funds. The general provisions regarding distribution between the States, methods of expenditure, etc., are similar to those in the Smith-Hughes Act for ordinary vocational training. On the basis of $2000 per person rehabilitated, which is now being used in estimates made as to the cost of re-training disabled soldiers, the maximum amount appropriated together with an equal amount from the States, would provide for the rehabilitation of only 1000 industrial cripples. Re-training the victims of industrial accidents may prove to be less expensive than re-training soldiers, but it is evident that it will be impossible to provide in this way for more than a small proportion of the number permanently disabled in industrial accidents every years. However, this move on the part of the Federal government will point the way for casualty companies and similar agencies to follow. Irrespective of humanitarian considerations, there can be no question that the cheapest way for society to take care of all but the few completely disabled victims of industrial accidents is to train them to do something useful with whatever faculties they may have left. It may easily be that this will ultimately revolutionize the entire system of casualty insurance for industrial accidents.

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The Shipyard Strike

The second month of the strike that has affected the shipyards and most of the metal shops of the Pacific Coast States has seen some notable developments. In the Los Angeles district the shipyards are running open shop under the Macy scale, employing in all about 10,000 men, and are reported to be turning applicants away. Most of the labor organizations affected have definitely abandoned the strikes originally called by them. At Tacoma, the yard of the Todd Drydock & Construction Company, the only important shipyard at that place, remains closed, and Mr. C. W. Wiley, president of the company, has rejected proposals for arbitration of the eight-cent-an-hour demand, also indicating in his reply that he does not favor operation under present labor conditions, irrespective of the scale of wages paid.

The shipyards and shops at Seattle and some of the yards and shops at Portland are paying the eight-cent increase. The yards at Portland that did not grant the increase, all of them wooden yards, are closed, while some of the shops that did not grant it are running non-union. There is, however, evidence of general dissatisfaction with present labor conditions among employers and business men generally at both places. In Seattle, the important commercial organizations from the Chamber of Commerce are advertising their support of what they call 'The American Plan', which includes opposition to the closed shop and to limitation of output. At Portland, the 'members' forum' of the Chamber of Commerce has recommended that the Chamber formally endorse the open shop.

Furthermore the northern shipbuilders have no illusions about the possibility of competition with Eastern and foreign yards under present labor conditions and with the increased wage scale. Definite announcement has been made that, with the completion of ships now under construction, which will be about January 1, two of the steel shipyards of the Portland district, those of the Northwest Steel Co. and the Columbia River Shipbuilding Corporation will be closed. At Seattle, the Skinner & Eddy Corporation has launched the last ship under its contract with the Emergency Fleet Corporation, and is about to close its No. 2 yard, except for the operation of the drydock.

In the San Francisco Bay district, the first public move by the employers was on November 13, when full-page advertisements appeared in the local newspapers signed by the California Metal Trades Association. This statement reviewed the local situation, presented arguments to refute the charges made by the unions of violation by the employers of the agreement prepared last August, and announced the opening of employment offices where men who desired to return to work might register. It was further stated that if sufficient applications were received by November 19 to justify resuming operations, the yards and shops would reopen at some date to be announced, and that the Macy scale would be maintained for one year from October 1. Neither the 'open shop' nor the 'closed shop' were specifically mentioned in the announcement, but the statement was made that "When the yards and shops reopen, it will be only under conditions which will guarantee the elimination of abuses which crept in during the War, such as deliberate reduction of output, the silent strike, the boycott, restriction and manipulation of the local labor market".

On November 18, a second advertisement appeared, giving a report regarding the number of men applying for work, reiterating some of the earlier statements, pledging all possible protection to employees in case of violence when the yards resumed operations, and declaring that "Union and non-union men will be employed without discrimination". Meetings of the policy committees of the California Metal Trades Association and the California Foundrymen's Association were held on November 19 and of the entire membership on November 21. On November 22 a third advertisement signed by both associations appeared announcing the re-opening of the shipyards, shops, and foundries in the district on November 24 under the conditions outlined in the earlier statements. It was further stated that no attempts would be made to bring men from other localities for ten days after opening, and then only in case the number of men returning to work is not sufficient to man the yards. The Associations also announced that "Yards, shops, and foundries shortly after resuming operations will determine upon a policy of individual shipyard or shop collective bargaining".

When the yards and shops reopened on November 24 shop rules were posted by the Associations, which announced that restriction of apprenticeship would not be tolerated, defined the terms helper, specialist, improver, and laborer, stated that foremen and assistant foremen must sever connection with the union, and declared definitely against any rules or customs limiting production, including jurisdictional claims to enforce the use of men from several crafts on work that can easily and economically be performed by one man.

Shortly after the first announcement from the employers appeared, the Bay Cities Metal Trades Council issued a statement reiterating charges of bad faith in connection with the original agreement and calling on the California Metal Trades Association to submit the entire controversy to arbitration by three judges to be selected from the higher courts of the State. Several of the individual unions affected passed resolutions refusing to call off the strike. The Metal Trades Council also met on November 25 and declared all shipyards of the district 'unfair'.

Approximately 5000 men returned to work on November 24, the day the shipyards reopened, and the number of men at work increased steadily during the week. At the time of going to press it was as yet uncertain whether or not sufficient men would return to work to render bringing men from the outside unnecessary. Many commercial shops and foundries also opened during the week, although with a relatively small force at the beginning.

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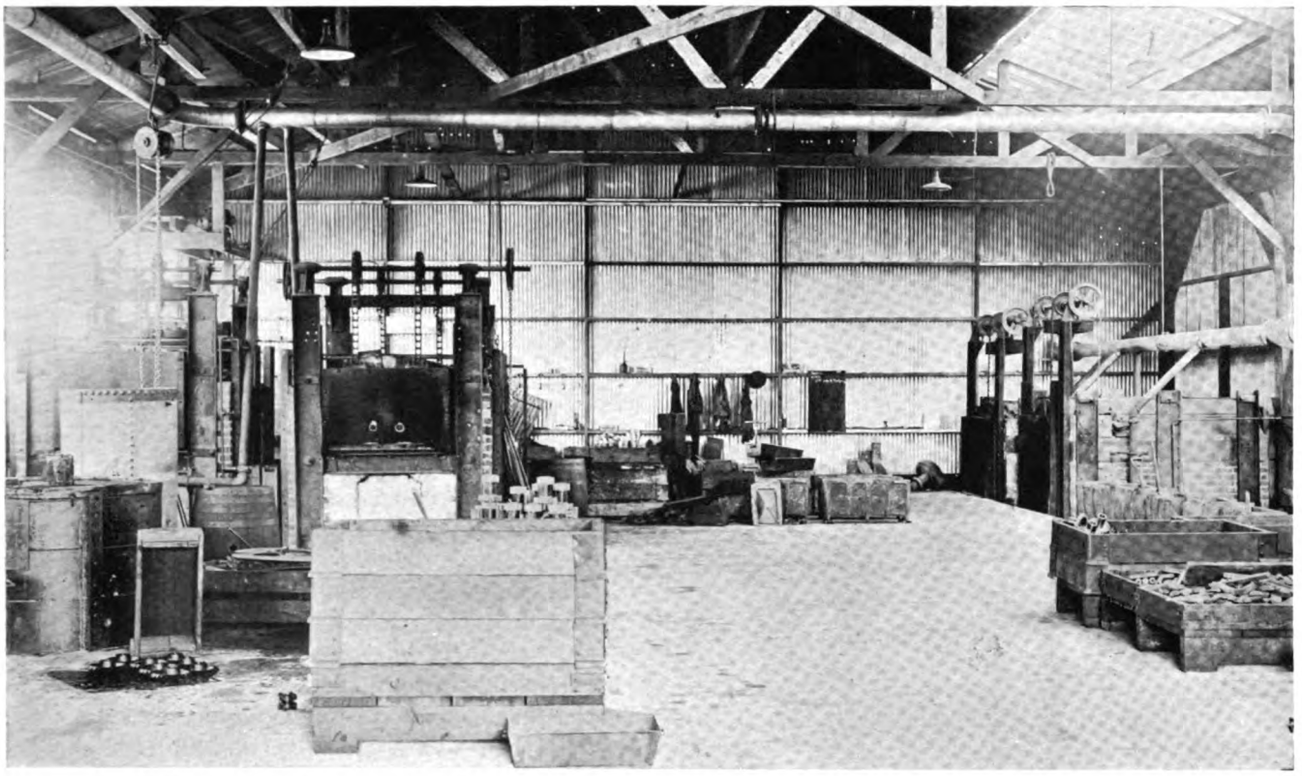

FIG. 1. GENERAL VIEW OF HEAT-TREATING DEPARTMENT. HEAT-TREATING FURNACES ON LEFT. CASEHARDENING FURNACES ON RIGHT

Heat Treating at the C. L. Best Tractor Plant

The service demanded from the modern tractor is as heavy or heavier than that required from any other kind of machinery, while a breakdown usually means a heavy expense over and above the mere cost of replacement or repairs. A high grade of material is therefore necessary for most parts, and this usually means some form of heat treatment. A large proportion of the parts used in the construction of the tractors made by the C. L. Best Gas Traction Co., San Leandro, are heat treated, and the company's equipment for doing this work ranks with the best heat-treating departments in metal-working plants on the Coast.

The heat-treating department is housed in a separate building from the rest of the plant and contains two furnaces for carburizing and annealing, having the hearths level with the floor, two large re-heating and hardening furnaces and several smaller ones for hardening and drawing. Space is provided, as will be seen in Fig. 1, for six more carburizing and annealing furnaces. The furnaces are oil burning. A feature of the burner equipment is the use of air at only 1 lb. pressure. Formerly the burners were supplied with air at 100 lb. pressure from the factory's main compressor plant. The pressure varied considerably during the day with the demand from other parts of the plant and the supply occasionally failed entirely because of breakdowns. Now a single General Electric compressor operated by a 5-hp. motor supplies all requirements. Space is available and piping arranged for two more compressors, which will be enough to supply all the furnaces that can be installed in the building.

With the exception of the track-links and parts, which are of manganese-steel, and which are delivered heat treated by the American Manganese Steel Co., the various important steel parts used in the company's tractors are given some form of heat treatment. The main bevel drive-gear and pinion, shown in Fig. 2, must have special strength, hardness, and toughness and are therefore made of nickel-steel, furnished by the Midvale Steel Co., containing 3.50% nickel and about 0.40% carbon. Some other smaller parts are also made of nickel-steel. Among these are the bolts holding in place the larger drive-gear already mentioned. The nickel-steel parts are heated above the critical temperature, quenched, and drawn in oil. To prevent warping, the large drive-gears, which are 17½ in. diam. and weigh 51 lb. finished, are held during the quenching in a Gleason press. The press gives a pressure of 4000 lb. This press furnishes a satisfactory way of handling such large pieces without loss from warping. It is not needed for the smaller gears and other pieces, as the warping, when it occurs at all, amounts to only a few thousandths, which is taken care of by the grinding.

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All the furnace walls, roofs, and doors are built with 4½ in. of insulating brick, and are provided with openings at both front and rear at three different levels for the insertion of pyrometer-tubes and for observing the interior

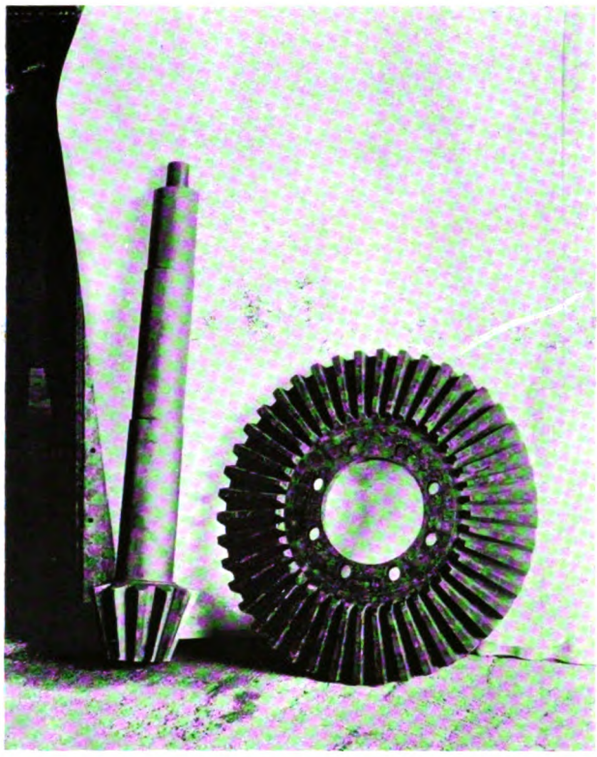

FIG. 2. NICKEL-STEEL DRIVE-GEAR AND PINION

that the uniformity of temperature within the furnace can be tested. The furnace-doors are fitted with Hyatt roller-bearings, which renders them easy to operate. The two furnaces for heat treating are arranged with doors at both ends. At one end of the furnace is a water-quenching bath and on the other an oil-quenching bath. A mineral oil is used, which is kept at or below 200°F. by a circulating system in which the oil circulates through pipes in the cooling-water. The water in the water-quenching bath is kept at or below 75°F. The oil for drawing is heated to temperatures ranging from 400 to 600°F., according to the hardness required. The length of time the part is kept in the drawing-oil ranges from 15 to 20 minutes for small parts up to 45 minutes for large pieces after reaching the desired temperature.

For all other gears and pinions, high-carbon steel forgings, ranging from 0.35% to 0.50% carbon, are used. The use of steel castings for either gears or pinions has been abandoned by the company. Gears are heated and quenched in oil, while pinions, since they receive more wear, are quenched in water to give them greater hardness.

Such parts as track-roller shafts, wrist-pins, and some studs, bolts, and nuts, rocker-arm shafts, and thrust-washers are casehardened. A mild steel containing approximately 0.20% carbon is used. The carburizing material contains ground coke, lime, and mineral oil, thoroughly mixed by machine. The parts are packed in the boxes and kept in a temperature of 1650 to 1750°F. from six to twelve hours, according to the size of the piece and the depth of case required. Where a hard surface is the main requirement, the pieces are re-heated and quenched only once, while if refinement of core is also required, there are two or three heatings and quenchings. The hardness of case varies from 75 to 100, according to the requirements for the particular part.

Some of the forgings used are furnished by companies that are so well-equipped for annealing and so thorough in their methods that further annealing is unnecessary. Most of the steel forgings, however, and all of the steel castings used in the manufacture of the company's tractors are annealed after being received. The parts are heated in the furnace to the proper temperature and held at that temperature from one to two hours, according to the size of the piece, the larger pieces taking the longer time. They are then cooled in the furnace to a point below the lowest critical temperature of the steel, about 900°F., then usually removed from the furnace and allowed to cool the rest of the way in the air.

Annealing is also employed for a number of the cast-iron parts. This has been found to be particularly advantageous for the pistons, as the casting-strains are eliminated, the general structure made more uniform, and the piece can be machined more easily. In addition, there is considerable advantage in having the piston softer than the cylinder. In addition, the lighter castings of all kinds are annealed, as it has been found that the greater ease of machining alone more than offsets the extra expense. For annealing cast-iron parts the furnace is brought to 1460°F., held at that heat until the castings are thoroughly 'soaked', and then allowed to

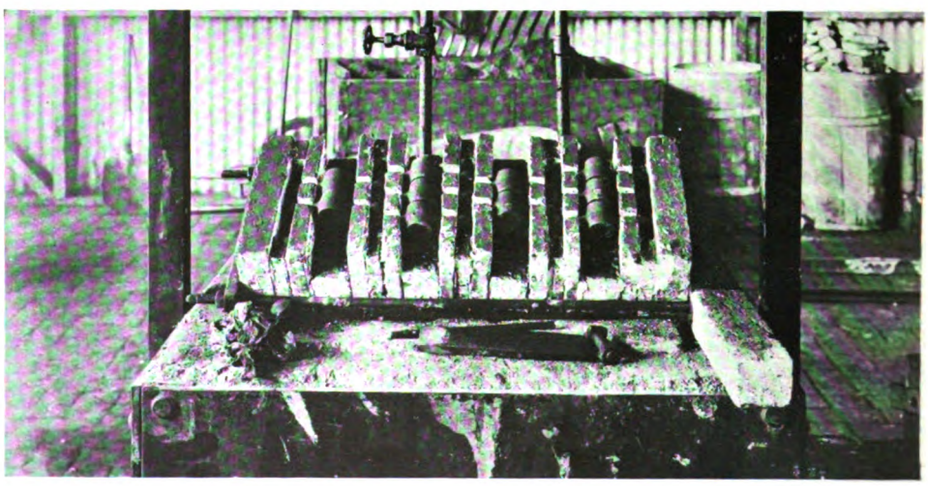

FIG. 3. SMALL FURNACE, AND RACK FOR SPECIAL HEAT TREATMENT

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cool to 400 to 500°F. The castings are then removed and cooled in the air.

Fig. 3 shows a small furnace, used principally for heat treating pieces only parts of which are to be hardened. The rack, of firebrick, which in this case contains rocker-arms, is constructed so as to allow certain parts to get the full heat, while other parts are not raised to the critical temperature. In quenching, the entire piece is immersed, and is then drawn in oil. This procedure prevents the formation of a sharply defined line between the hardened and unhardened parts.

In addition to making fracture, file, and hammer tests, both the Brinell machine and the scleroscope are used in testing the finished product, and this is also done to a considerable extent with the material as it comes to the heat-treating department. This procedure was found to be particularly useful during the War, when the steel furnished by many companies under a given specification varied considerably in physical properties. In some cases it was found to be advisable to make a hardening test of each bar, grading the bars according to results, and then giving the appropriate heat treatment, while if they had all been treated alike, the results would have been unsatisfactory for many pieces.

Every gear is tested after treatment in the Brinell machine, two opposite teeth being tested. This ensures detection of any appreciable lack of uniformity in hardness. With other parts such as track-roller shafts, enough pieces are tested from each heat to give a good idea of the properties of the entire lot. A particular advantage of the use of the Brinell machine is that any serious error in reading the hardness can be checked at any time before machining by a rough comparison of the impression left by the ball with the recorded hardness.

Acknowledgment should be made to Walter Grothe, engineer for the C. L. Best Gas Traction Co., for assistance in preparing this article.

RECOMMENDED AMERICAN MERCHANT MARINE POLICY

The Chamber of Commerce of the United States has submitted to its 1236 member organizations the recommendations of its Committee on Ocean Transportation the disposition that the U. S. Shipping Board should make of the two thousand or more merchant vessels it now possesses, or has under contract. The Committee's recommendations are:

1. That wooden vessels, and steel vessels under 6000 tons deadweight, be sold on the best terms obtainable from American or foreign bidders.

2. That other government-owned vessels be sold to regional associations for transfer at cost to private individuals and corporations of the several regions.

3. That the Government absorb the difference between the war cost and the present value, as a war loss.

4. That there be freedom from regulation as to routes and rates.

5. That there be restriction for a period of years upon transfer to a foreign flag of steel vessels over 6000 tons deadweight purchased from the Government.

6. That preference be shown for American underwriters, and that the underwriting market of the world be used for insurance not covered by American underwriters, without intervention by Government insurance.

7. That encouragement be given to an American classification society.

8. That Congress be asked to make a general declaration of a policy of giving aid to the maintenance of a privately owned and operated American merchant marine.

9. That the operation of the competent American shipbuilding yards, on private account both as to yards and the vessels they construct, be continued.

The committee which prepared the report is made up of Edward B. Burling, Washington, chairman; John F. Deems, Burlington, Iowa; M. E. Farr, Cleveland; Homer L. Ferguson, Newport News; C. F. Gregory, New York; B. F. Harris, Champaign, Illinois; Charles H. Jones, Boston; Frederick J. Koster, San Francisco; August F. Mack, New York; N. Summer Myrick, Boston; John H. Thomas, New York; Samuel W. Weis, New Orleans; Egbert W. West, Glens Falls, New York.

ACTIVITIES OF THE U. S. BUREAU OF STANDARDS

In order to determine the power required, and, consequently the efficiency of different types of cutting tools, a planer in one of the Bureau of Standards has been provided with a dynamometer, which accurately measures the work done during the operation of cutting. Preparatory to the research on the economy of different types of cutting tools, this dynamometer has been calibrated by dead-weight loading. Also, it is planned to study the heat-treatment used in tool construction, and for this purpose pyrometers and potentiometers have been calibrated and are now ready for the investigation. A comprehensive program is being planned in co-operation with machine-tool manufacturers.

Recently a conference was held between representatives of the Bureau, the American Society for Testing Materials, and the U. S. Railroad Administration, on the question of the phosphorus and sulphur limits for specifications of various grades of steel. This question is of great economic importance because of changing conditions relating to several factors of steel manufacture, such as the gradual increase of phosphorus in available iron ores, the large amount of high-sulphur scrap, and the poor quality of fuel with its high-sulphur content. A tentative program of laboratory investigations and service-tests has been mapped out involving co-operation of steel manufacturers, users, and the Bureau.

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Fundamental Principles of Safeguarding

By SYDNEY J. WILLIAMS*

If you want your plant to be 100% safe, it is necessary to guard every moving part, wherever located, on which a workman might be injured if he came in contact with it in any way or from any cause whatsoever. If the moving part is in a place 'where nobody ever goes', remember that some one is likely to go there sooner or later in connection with the repair or maintenance or alteration of the machinery itself or of the building, or for some other reason that you cannot anticipate. You probably have heard the story—perfectly true—of the man whose heel was cut off by an unguarded gear 14 in. below the ceiling. The man was standing on a scaffold, working on another shaft near-by; to brace himself he placed his foot against the shaft on which the unguarded gear was located, his foot slipped, and was caught in the gear. Many similar examples could be quoted of accidents occurring in out-of-the-way places. Recognizing this fact, the Illinois Steel Co. rule-book, to mention only one example, requires that all gears, wherever situated, must be enclosed.

You may be puzzled by attempting to apply this principle to the guarding of overhead shafting and belts. Many shops contain miles of overhead shafting which it is almost a physical impossibility to guard. On the other hand, oilers and repairmen are frequently injured, sometimes fatally, on unguarded overhead shafting or belts. The only solution is, if the shafting positively cannot be guarded, to prohibit absolutely any work on such overhead transmission while it is in motion. Shortening of belts and other repair work, as well as oiling, can be done during the noon hour or at night; or, better still, install automatic oilers or oilers that can be filled from the floor by using a special oil-can with long spout. For details, see the National Safety Council's Safe Practices pamphlet on this subject.

A gear or belt or other dangerous moving part which happens to be placed below a table, or in some other place where it is partly hidden, is not thereby made safe. Someone occasionally must reach under the table to sweep or repair the floor or oil or repair the machine. Someone may slip or stumble so that his arm comes in contact with a gear or belt which would be safe for the workman standing in his normal position. The immigrant totally ignorant of machinery—and it is hard for us to realize the completeness of the ignorance on this subject, on the part of foreigners brought up in farming districts—may deliberately put his hand or his finger into an opening that looks interesting, just to see what it is. If he finds that 'it' is an unguarded gear, it is easy to say that the accident is his own fault, but that does not relieve our obligation to pay his compensation nor does it restore him to his vacant place in the gang.

What I have said of gears and belts applies equally well to any moving part on which a man might be injured: counterweights, cranks, reciprocating parts such as a planer-bed, and so on; also, of course, to the operating point of machines.

Here are a few points to remember:

(1) A safeguard should be so designed and constructed that it will prevent accidents on the part guarded: not accidents to the operator while at his regular work, but also to the operator or passers-by in case they slip or fall or carelessly touch the machine while it is in motion.

(2) The guard should not interfere with production. If it does, it is likely to be taken off. In designing a guard it is generally wise to consult the man who will use it.

(3) In general, the guard should be attached to the machine and not to the floor; if attached to the floor, use a connection that will interfere as little as possible.

(4) The guarded part must be easily accessible for oiling, inspection, and repair. The door or removable section provided for this purpose should be hinged or otherwise attached to the remainder of the guard, or to the machine. If not, it is likely to be left off permanently.

(5) The guard should not interfere with cleaning and sweeping around the machine. It should, therefore, be kept generally about six inches above the floor.

(6) The guard should be strong enough to resist injury and keep its shape. A light flimsy guard soon becomes bent and is discarded. A substantial guard is cheaper in the end.

(7) Incombustible guards are preferred. Wooden guards, soaked with oil, may become a serious fire-hazard. Metal guards are neater and wear much better. "Metal guards look as if you wanted to; wooden guards look as if you had to." Guards may be made of cast-iron, sheet-metal, wire-mesh, expanded or perforated metal, or slats. However, where subjected to acid or fumes, wooden guards may be necessary.

(8) It is desirable to interlock the guard with the operating machines, where possible, so the machine cannot be operated unless the guard is in place.

(9) A safeguard can often be so designed that it will also serve to prevent wear on the parts guarded, for example, a solid gear enclosure.

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Let us consider the application of these suggestions to the design of gear-guards. Cast-iron guards are preferred because they may be made to fit more snugly, present a better appearance, and protect the gears from dust and injury. In shops having similar gears on several machines, the cost of patterns and cast-iron guards will be no greater than the cost of 'built-up' guards. A cast-guard of one machine may be used as a pattern for making guards for similar machines.

Guards for a variety of machine, and in many sizes, may be more cheaply made of sheet-metal. In large guards, an angle-iron is used to make the joint between the flat sides and the curved part of the guard. In smaller guards this joint may be made by cutting projections, like saw-teeth, on each side piece and bending those over to form a smooth curve. The joint may then be made either by spot-welding or by riveting. Short pieces of angle-iron may also be used to form the joint —about ¾ by ¾ by ⅛ in. angles, one inch long, 3 or 4 inches apart.

Gears should be completely encased; or, where this is impracticable, should have a band-guard with side flanges extending inward beyond the root of the teeth. If there is a spoke-hazard, the gear should be completely enclosed, or filled in between the spokes.

Bolts, fly-wheels, shafting, and large gears are often guarded by an open-work rather than a solid enclosure. Such guards should be so designed that no one can get his hand or his finger into the danger-point even if he tries. If the guard comes within four inches of any danger-point the opening should not be greater than half an inch square, which is small enough to exclude fingers. If more than four inches away, which is about the maximum length of a man's finger, the openings may be larger than half an inch, but not larger than two inches square, which is small enough to keep out a man's hand. If a slatted construction is used the slats should not be more than one inch apart.

The safety engineer's greatest difficulty is in guarding machines on which men are working. Let me repeat that it is very important not to attempt to guard machines in a way that will interfere with production. The great majority of both foremen and workmen will object seriously to such a guard, will use it under protest, and when the opportunity arises they will take it off and not put it back. I have time to mention only two examples: the circular saw and the punch-press.

A guard is not the only essential for safety in operating a circular saw. For ripping, it is important that the saw be provided with a splitter. Keeping the saw sharp and properly set will greatly decrease the danger of throwbacks. The floor where the operator stands should have a nonslip surface. Many shop-men say that it is impossible to guard a circular saw without interfering seriously with operation. The safety rule-book of a large company contains a similar statement. In a great majority of the wood-working shops that I have visited, some, at least, of the saws have not been guarded or some of the guards have not been in use. I remember, however, two wood-working shops where every saw was guarded and every guard was in use: the Westinghouse Electric & Manufacturing Co., at Pittsburgh, and the Commonwealth Steel Co. at Granite City. There doubtless are others but I do not happen to have seen them. In each of these two shops every circular saw was provided with a guard that completely covered it when not in use and which rose automatically from the table as the stock was inserted. I watched men operating these saws and the guards did not seem to introduce the slightest difficulty. They were of light construction and when the stock was shoved in they rose without apparent effort, the larger ones, at least, being counterweighted. The men in charge of these departments told me that the guards did not interfere at all with production, in fact that the men now would not work without them because they felt that they were so much safer. I do not blame the workman or the foreman who objects to using a cumbersome, heavy, non-adjustable guard.

Special work on circular saws sometimes is difficult to guard. In some cases, these difficulties may be overcome by careful study. In a few cases they probably can not, and the guard must be temporarily laid aside, being hinged or pivoted for that purpose. Where this must be done, another safeguard can often be introduced. For example, in grooving the edge of a board, provide an auxiliary guide or fence, so that there will be a guard on each side of the saw, thus keeping hands away from contact with it.

The punch-press, using that common term to include all kinds of power presses, has, with the circular saw, the doubtful honor of causing more injuries, and especially more permanent injuries, than any other kind of machine. Where possible, the best guard is an enclosure around the plunger, which makes it impossible to get one's fingers underneath. Often, however, this is impossible. In such a case, let me suggest that instead of buying a dozen or a hundred of some so-called safety device, and putting it on every punch-press in the shop, you start with one individual press and study the operation carefully in co-operation with the superintendent, foreman, master mechanic, and operator of the machine. Ask yourself why accidents happen or why they may happen on the particular press you are studying. The answer will be that, for one reason or another, the operator finds it necessary or convenient to put his hand under the plunger, either regularly or occasionally. The way to make the operation safe, then, is to arrange it so that the operator need not and will not put his hand under the plunger. Sometimes this may be done by cutting away a portion of the dies so that the operator can keep hold of a part of the piece being formed and still not be injurel. Often it may be accomplished by introducing an automatic or a foot-operated kick-out. This almost always increases production as well as safety. Sometimes it is found practicable and advantageous to interchange the upper and lower dies. Sometimes the method of operation may be altered; I have in mind one case where, in riveting the handle-socket onto a kettle, the operator laid the rivets in position after the kettle was in the machine and sometimes the plunger came

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down and caught her finger. After a good deal of study the superintendent arranged to have another girl place the rivets in position and hand the kettle to the operator, who then placed it in the press and completed the operation, obviously without danger and obviously with a great saving in time as well. In a great many cases, where the same operation is continued for a long time on one press, it will be found economical to provide some sort of automatic or semi-automatic feed; this also always increases production as well as removing the hazard. Gate-guards and two-handed operations are sometimes necessary, but should be used only as a last resort. The methods above are more efficient because they go to the root of the matter and remove the hazard rather than merely guarding it. When you remove the hazard you simplify the operation and therefore increase production. When you merely guard the hazard you may decrease production.

What I have said of the punch-press is typical of many machines. Safety engineering does not consist in simply building wire mesh-guards, nor in buying safety devices that look pretty in a catalogue, and putting them on the machine without regard to the wishes, the convenience, or the efficiency of the operator. The real safety engineer will, where necessary, study the operation of a machine until he understands it as well or better than the operator himself; as well as the foreman, the superintendent, the master mechanic; and then he will apply their brains and his own in working out either a guard, or a change in the machine, or a change in the operation, which will remove the underlying hazard and make the operation intrinsically safe.

Some Gauges and Tools for Automobile Repairing

The accompanying photographs show gauges and tools developed by B. Holmberg, foreman for the Peacock Motor Sales Co. Fig. 1 shows two gauges that have been found useful for repair work. The gauge on the right is used for lining up pistons. The base of the square rests on the arbor of the crank-shaft. Then if the piston is properly lined up the two tool points as well as the other leg of the square will rest against the side of the piston at the same time. A plain square without the points that give an adjustment in the third dimension does not give an accurate adjustment. At the left a micrometer surface-gauge is shown. This is used for checking up all bearings and races. It not only shows whether they are out of alignment but also how much.

Fig. 2 shows a handy wrench designed for turning the crank-shaft from the pit while working on the engine. The pin fits into the hole in the web and the jaw is clamped on the web by the eccentric.

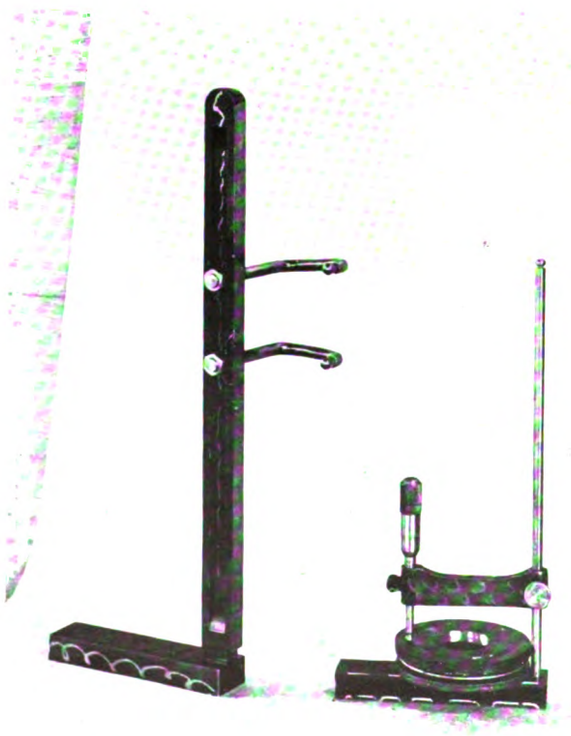

FIG. 1. GAUGE FOR LINING UP PISTONS AND SURFACE-GAUGE WITH BALL-RACE IN POSITION FOR CHECKING

FIG. 2. WRENCH FOR CRANK-SHAFT

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PART OF RIVETING DEPARTMENT

Manufacture of Machinery for the Fruit Industry by the Anderson-Barngrover Company

THIS is the story of a Pacific Coast concern that started in a small way and is now among the leaders in its particular line. Although based on the manufacture of patented articles, the business has been built up by developing a special line, and by a careful study of customers' needs in that special line. The patents will ultimately expire, but the demand for the company's machines will continue because their quality is known to its customers and the company's designers know the customers' needs.

A number of years ago, W. C. Anderson, an orchardist near San Jose, patented a prune dipper, which was an improvement on the outfits then in use for dipping prunes in lye solution preparatory to drying, and commenced making the dippers for his neighbors. Mr. Anderson represents the comparatively rare combination of mechanic and practical farmer, and he soon saw other possibilities for improvement in the machinery that he and his fellow-fruit growers were using. Nearly every year saw more patents granted and additional types of machinery constructed. After several years of existence, Mr. Anderson's firm got into litigation over patent rights with the firm of Barngrover & Hull, another San Jose concern

FIG. 1. GENERAL VIEW OF ASSEMBLY FLOOR

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making the same kinds of machinery. This litigation terminated in the amalgamation of the two concerns in the Anderson-Barngrover Manufacturing Co. From a local affair, the company's business has expanded until machines are now shipped to fruit-growing districts in all parts of the United States and even to foreign countries.

At the present time the company manufactures practically every kind of canning, fruit-packing, and fruit-drying machinery, all covered by its own patents. From 150 to 200 men are employed. In a sense the plant may be said to be on a manufacturing basis, but this statement requires some qualification. Jobbing work in the ordinary sense of the word is done only in exceptional

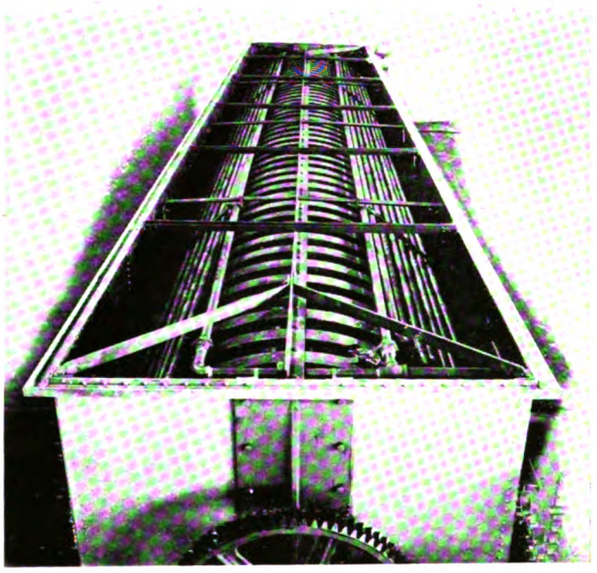

FIG. 2. CONTINUOUS COOKER, SHOWING DETAILS OF CONSTRUCTION

cases. However, the company's standard line includes over sixty machines, and this by no means represents the number of different kinds of machines built in the course of a year. Canners, packers, and dryers are all men of individual tastes, and most orders that are received call for some modification of the standard type of machine. In many cases the modified machine is really not so well-suited to the buyer's needs as the standard machine would be; in others the advantage gained by modification, while they exist, are really not so great as those that would be gained by standardization; but frequently it is true that the buyer needs a non-standard machine in order to meet his own problems successfully. In any case, none of the manufacturers of machinery for the fruit industry have reached the point where they can say to the buyer "Here is our machine. Take it or leave it," but are obliged to supply what the buyer wants, provided that they cannot 'talk him out of it'. It often happens that the modifications desired are so great that, while the basic patents of the company are utilized, the machine has practically to be built special 'from the ground up'.

The plant comprises departments for sheet-metal work, riveting, pipe-fitting, blacksmithing, machine work, woodworking, pattern, and foundry work. The foundry is rented to a practical molder, who runs the shop and makes the castings at a specified price per pound. Plates, sheets, angles, tees, and similar material are unloaded into the warehouse directly from the company's siding. The various tanks and similar equipment are built and tested in the sheet-metal and riveting shops at the north-west corner of the main building, the material moving in a straight line toward the assembling department, which is approximately at the centre of the building. The machine-shop, which is at the south-west corner of the building, delivers the machined castings to the assembling department, while the steam-coils come from the pipe-fitting shop just west of the main building, and the wooden parts come from the woodworking department in the eastern part of the building. It might be mentioned here that

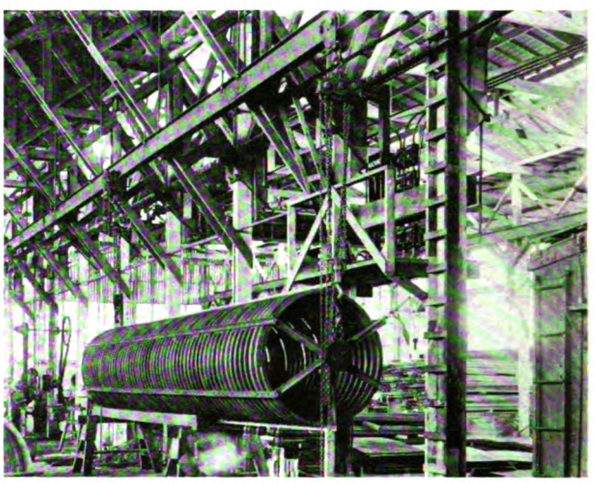

FIG. 3. SPIRAL FOR COOKER READY FOR RIVETING

the plant, like many other plants with a developing business, often suffers from growing pains, necessitating frequent re-arrangement of the shop facilities.

The Continuous Agitating Cooker has about the largest sale of any of the company's machines. This machine is used extensively in canneries where any kind of cooked food is turned out. Several of these cookers are shown in various stages of construction in Fig. 1, while Fig. 2 shows most of the details of construction. The cooker consists in substance of a heavy sheet-steel tank reinforced with angles and channels, and a reel of angle-iron on which the cans are placed and which revolves inside a spiral of angle and tee-iron. This guides the cans and holds them in position, while the revolving reel carries them from the receiving to the discharge-end of the tank. The rate of revolution of the reel can be varied to give the desired length of time of cooking, and there are also doors along the side of the cooker to permit the cans being taken out at any point. Suitable receiving and discharging mechanism is provided, and the reel can be turned by either an electric motor or a gas-engine. Fig. 3 shows the spiral swung in position for riveting.

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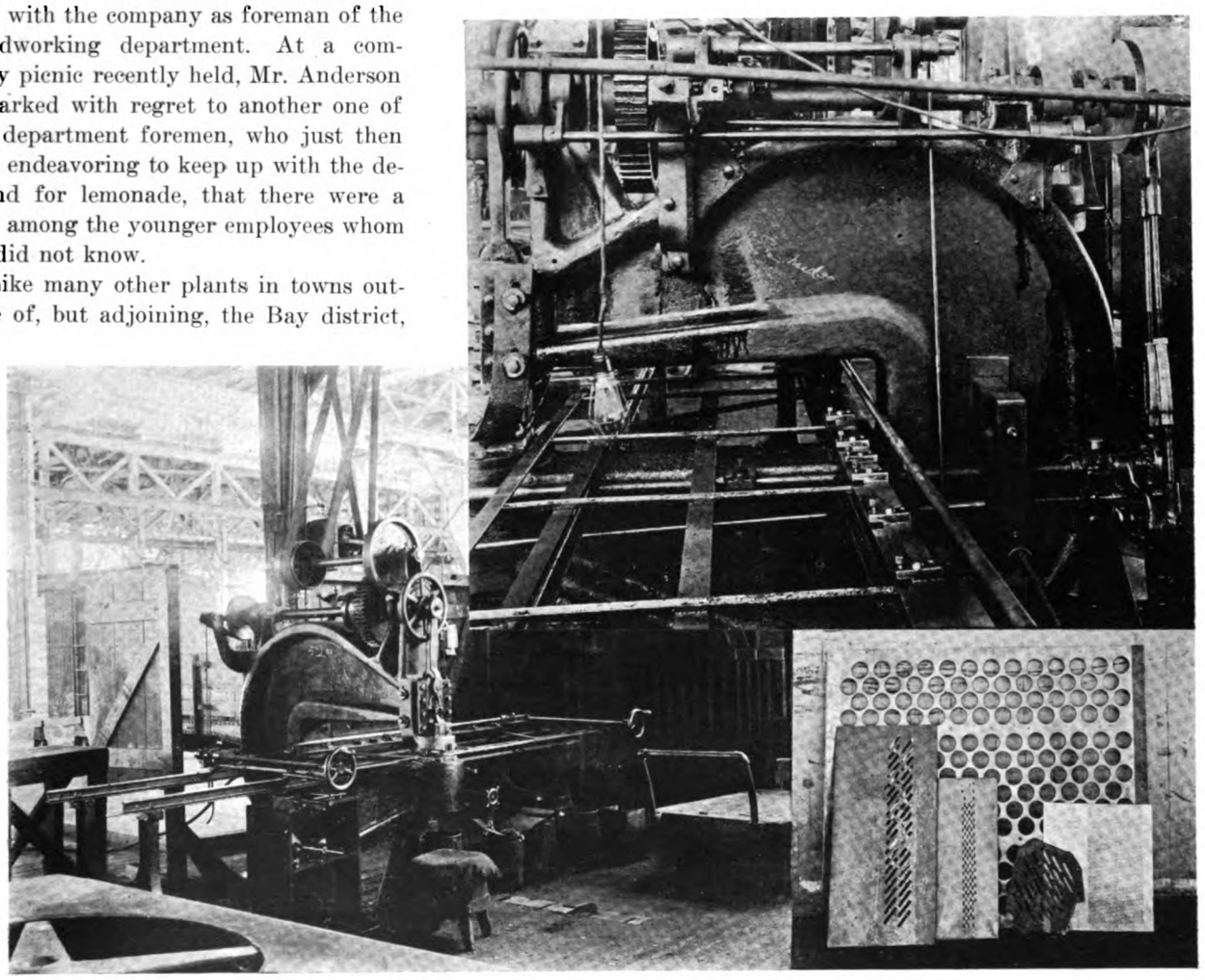
All bending of angle and tee-iron is done in the company's shop.

The peculiar requirements of the company's work call for various special types of machine-tools. Sometimes a machine is developed and built in the shop that is better suited to the work than any of the commercial machines. A large amount of screen punched from sheets is used, the screen with the large-sized holes being used for fruit-graders, and the smaller sizes for various purposes. The group of photographs shows a punch-press designed and built in the company's shop for this work. Punches for any size and shape of hole may be inserted. The cam-operated mechanism that shifts the sheet is shown on the right. Different cams are used according to the width of screen punched. Below are several specimens of the class of work done.

Unlike many modern plants, the Anderson-Barngrover company has not lost the personal touch between employer and employee that is commonly considered to be characteristic of the small shop. There are a number of men on the payroll that have been with the company for ten years or more. W. C. Anderson, 'father' of the business, is still president of the company and takes an active part in its management, while the 'first child', namely, the first hired employee, R. W. Nash, is still with the company as foreman of the woodworking department. At a company picnic recently held, Mr. Anderson remarked with regret to another one of the department foremen, who just then was endeavoring to keep up with the demand for lemonade, that there were a few among the younger employees whom he did not know.

Like many other plants in towns outside of, but adjoining, the Bay district, the company was affected by some of the shipyard labor disputes of the past few years, although the causes of these disputes were usually outside its own control. Finally, a strike was called in several departments last spring. Since that time the plant has been run open shop, with the exception of the foundry, which, as already noted, is under separate management, and is run as a union shop. In the other departments there is no discrimination whatsoever against union or non-union men as such. Before this strike most of the departments had been unionized. At present the company pays at least the union scale to both skilled and semi-skilled workers, and the more efficient workers make more than the union scale. In place of the mechanics who struck last spring, the company has found it practicable to pick up plenty of young men with mechanical ability and willingness to learn. These men are given fair wages, none of them less than $3 per day, while they are learning, given careful attention and instruction, and as soon as they were able to do the work were paid the union scale or better. While there was some reduction in output at first, the average production per man at the present time is greater than before the strike, whatever the department or the class of work.



PUNCH-PRESS FOR MAKING SCREENS. FOR DESCRIPTION SEE TEXT

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Safety Rules for Oxy-Acetylene Welding

The following rules for oxy-acetylene and oxy-hydrogen welding and cutting have been prepared by the Western Pennsylvania Division of the National Safety Council.

OXY-ACETYLENE EQUIPMENT

1. All pressure-tanks should be fitted with safety relief-devices, and tanks not so equipped should not be used.

2. The equipment should include a high-pressure gauge to indicate the pressure on the tank, a reducing-valve, and a low-pressure gauge to indicate the pressure on the torch. These should be assembled as one unit and so arranged that they need not be separated when they are attached to, or detached from, the tank. The two gauges should have different-sized openings; one should have a right-hand thread and the other a left-hand thread so that they cannot be interchanged. There should be one of these units for the oxygen-tank and one for the acetylene-tank.

3. All pressure regulators should be equipped with a safety relief-valve, which will relieve the pressure from the diaphragm and low-pressure gate in case the high-pressure valve should develop a leak.

4. Wire-wrapped hose should not be used.

5. The oxygen and acetylene hose should be of different color or the couplings should be stamped for identification purposes, so as to avoid interchanging the hose.

6. The torches should be of a type which will not backfire.

RULES FOR OPERATION

1. Under no condition should acetylene be used where the pressure is greater than 15 lb. per square inch.

2. Special care should be given to the storage of oxygen and acetylene tanks. Acetylene is classed as an explosive, and only a limited number of containers should be stored in any one place. Oxygen-tanks should be stored in a separate place from acetylene-tanks.

3. Oxygen and acetylene tanks should not be allowed to remain near stoves, furnaces, steam-heaters, or other sources of heat, and should not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the tank. Any excess of heat may also soften the fusible safety-disk with which the tank is provided, causing it to blow out and permitting gas to escape.

4. Oxygen-tanks should never be handled on the same platform with oil or grease, which might find their way into the valves on the tanks.

5. Oxygen and acetylene tanks should never be dropped nor handled roughly and should never be stood on end unless fastened so as to prevent them from falling over.

6. Tanks should not be handled by cranes, either magnetic or mechanical.

7. All empty tanks should be marked plainly with the word 'empty' and returned promptly to the storeroom.

8. An open flame should never be used for the purpose of discovering leaks in acetylene-tanks. Leaks can generally be detected by the odor of the acetylene gas, and their position can be determined by applying soapy water to the surface of the tank and watching for the soapy bubbles formed by the escaping gas.

REPAIRS TO EQUIPMENT

1. No repairs to oxygen or acetylene tanks or equipment should be made or attempted. All defects should be reported promptly to the foreman, and by him to the manufacturer.

2. Leaking acetylene-tanks should not be used, but should be placed in the open air and all open lights kept away from them. All leaking acetylene-tanks should be reported promptly to the foreman and immediately returned to the manufacturer.

3. All open flames should be kept away from any place where there is any possibility of acetylene escaping.

4. Care should be taken to protect the discharge-valves of tanks from being bumped, as a jar may damage the valve and cause it to leak.

5. Grease in contact with oxygen under pressure may cause spontaneous ignition. Great care should be taken not to handle threads or valves with oily hands or gloves, and gauges should not be tested with oil or any other hazardous carbon. If a lubricant must be used, the purest glycerine is permissible.

6. Gauges, apparatus, and torches requiring repairs should be sent to the manufacturer, and local repairs should not be attempted. Valve-seats should never be replaced except by the manufacturer.

USE OF PRESSURE-REGULATOR

1. The use and operation of the pressure-regulator or reducing-valve on oxygen or acetylene tanks should be as follows:

a. Open the discharge-valve on the tank slightly for a moment and then close it. This is to blow out of the valve any dust or dirt that might otherwise enter the regulator.

b. By means of the stud or nut connection on the regulator, connect the regulator to the discharge-opening of the tank.

c. Release the pressure-adjusting screw of the regulator to its limit.

d. Open the needle-valve slightly, if there is one.

e. Open the discharge-valve on the tank gradually to its full width.

f. Open the needle-valve to its maximum, if there is one.

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g. Adjust the pressure-regulating screw until the desired pressure is shown on the low-pressure gauge.

2. The discharge-valves on the tanks should be opened slowly, and care should be taken to avoid straining or damaging them by the use of a hammer or the wrong kind of wrench. A special wrench should be made for use in opening these valves in case they stick.

3. When the operation of the cutting or welding torch is stopped for a short time, the needle-valve on the regulator should be closed, or the pressure-adjusting screw should be released to keep the pressure off the hose. The torches should be opened momentarily to let the pressure out of the hose-lines.

4. All tanks should be inspected at the close of the day's work.

5. Proper precautions should be taken to protect the hose from flying sparks.

HOSE AND JOINTS

1. All hose should be examined periodically at least once every week. This should be done by cutting the hose off at the end of the connection and examining it. In addition, after a few months use, the hose should be cut off about two inches back of the connection and examined for defects. A defective hose should never be used.

2. Special care should be taken to avoid the interchange of oxygen and acetylene hose or piping, as this might result in a mixture of these gases that would be highly explosive. The practice of using right and left hand threads is recommended.

3. White lead, grease, or other similar substances should never be used for making tight joints. All joints and leaks in equipment should be made tight by soldering or brazing.

4. The oxygen and acetylene valves at the base of the torch should be tested daily for leaks.

5. Where hydrogen or other gas is used instead of acetylene, the same precautions should be observed as for acetylene.

6. A fire-extinguisher should be carried as regular equipment to be used in case of fire.

7. Men using welding apparatus should wear suitable welding-goggles for eye protection, having frames that are non-conductors of heat (not celluloid), side-shields to protect against hot particles of metal, and lenses of proper color.

8. Operator's clothing should be fireproof.

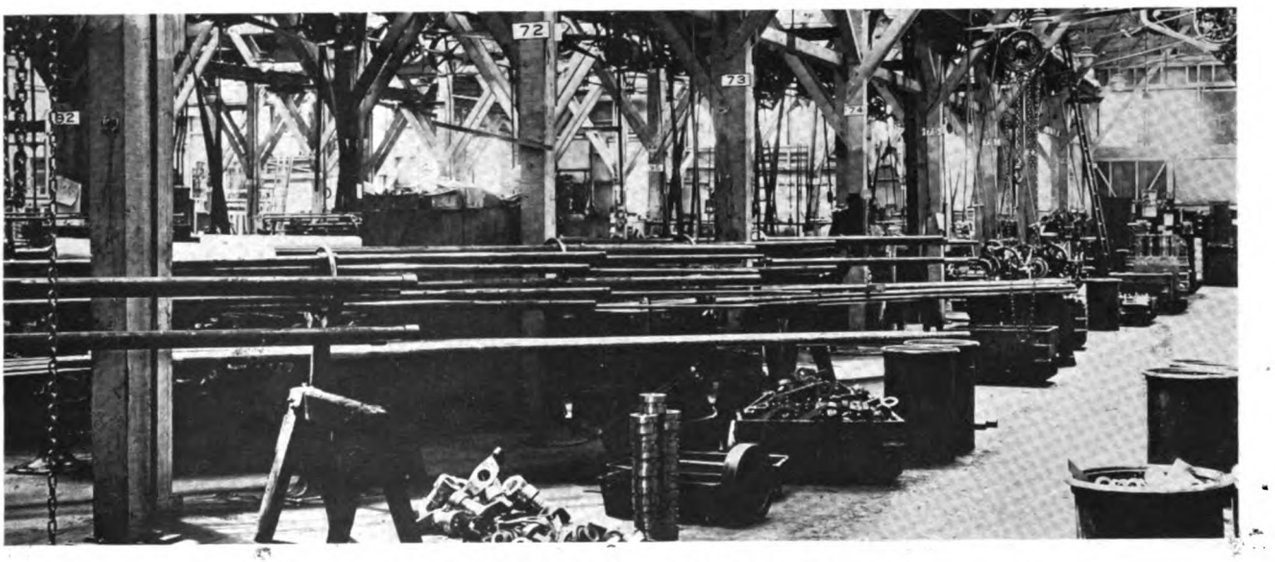
9. If valves become frozen, they should be thawed by hot water, not by flame or hot metal rod.

ENGLISH COMPANY DEVELOPS PROCESS FOR ROLLING MANGANESE STEEL

It is reported in 'Grits and Grinds' that Edgar Allen & Co., Ltd., of Sheffield, England, are rolling steel containing 12% to 14% manganese. The process used is their own, and is covered by patents to which they have sole rights in the United States and Europe.

EFFECTIVE GUARD FOR AUTOMATIC SCREW MACHINES IN HOLT MACHINE-SHOP

The accompanying illustration shows the guards used on a battery of Gridley automatic screw-machines in the machine-shop of The Holt Manufacturing Co. at Stockton. While there is no trouble when the rods feeding the machine are short, there is considerable difficulty in handling the rods when they are long, in order to keep them from switching about, unless a guard of the type illustrated is used. As will be seen from the illustration, the rods run in pipes about 2 in. diam., which are held in place by being bolted to standards. Vibration of the rods is reduced to a minimum. Next to the machine, a guard consisting of a piece of sheet-iron bent in the form of a semi-circle is used. Two of these are shown in the illustration.



GUARD FOR RODS ON AUTOMATIC MACHINE

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'Speeding-Up' Production on Automobile Work

Many employers, when discussing methods of obtaining increased production, assume that the responsibility lies solely upon the workman, and appear to long for labor conditions that would permit them, without making any change in their shop facilities, to go into their shops, and by 'driving' their men bring up the production 100%. At the plant of the Mann Manufacturing Co., of San Francisco, a different policy is pursued. An open shop is maintained without discrimination against either union or non-union men, and the company endeavors to pay as good wages as possible, raising a man's pay as soon as he has shown himself capable of earning the increased rate. A workman is expected to do his best, but at the same time every effort is made by the company to introduce the best methods for doing the work, and to supply the employee with equipment that will enable him to do the work by the best methods, and also that will reduce the laboriousness of the work to a minimum. In fact, the company takes the position that until an employer has taken such measures, he has failed to do his share, and has no right to ask the employee to assume the entire burden of increased production.

The accompanying photographs show some of the methods used by the company for handling its automobile-repair work and for making automobile parts. Fig. 1 shows the making of ring-gears to be used with automobile flywheels. The blanks as received from the forge-shop are just plain rings. This machine hobs the teeth complete. Facing is done on another machine. Some of the completed rings are shown in the foreground. Fig. 2 shows a Heald grinder grinding automobile cylinders. The jig shown permits quick centring

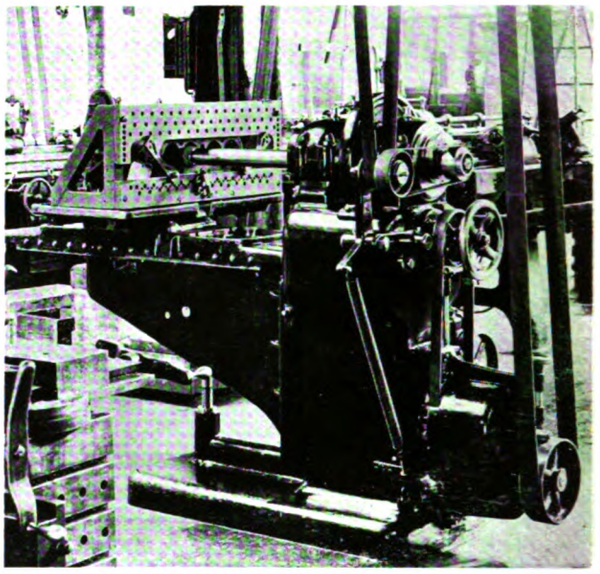

FIG. 2. GRINDING AUTOMOBILE CYLINDERS ON A HEALD MACHINE

and also shifting from one cylinder to the next.

Fig. 3 shows a Lo-Swing lathe manufactured by the Fitchburg Machine Works, of Fitchburg, Massachusetts,

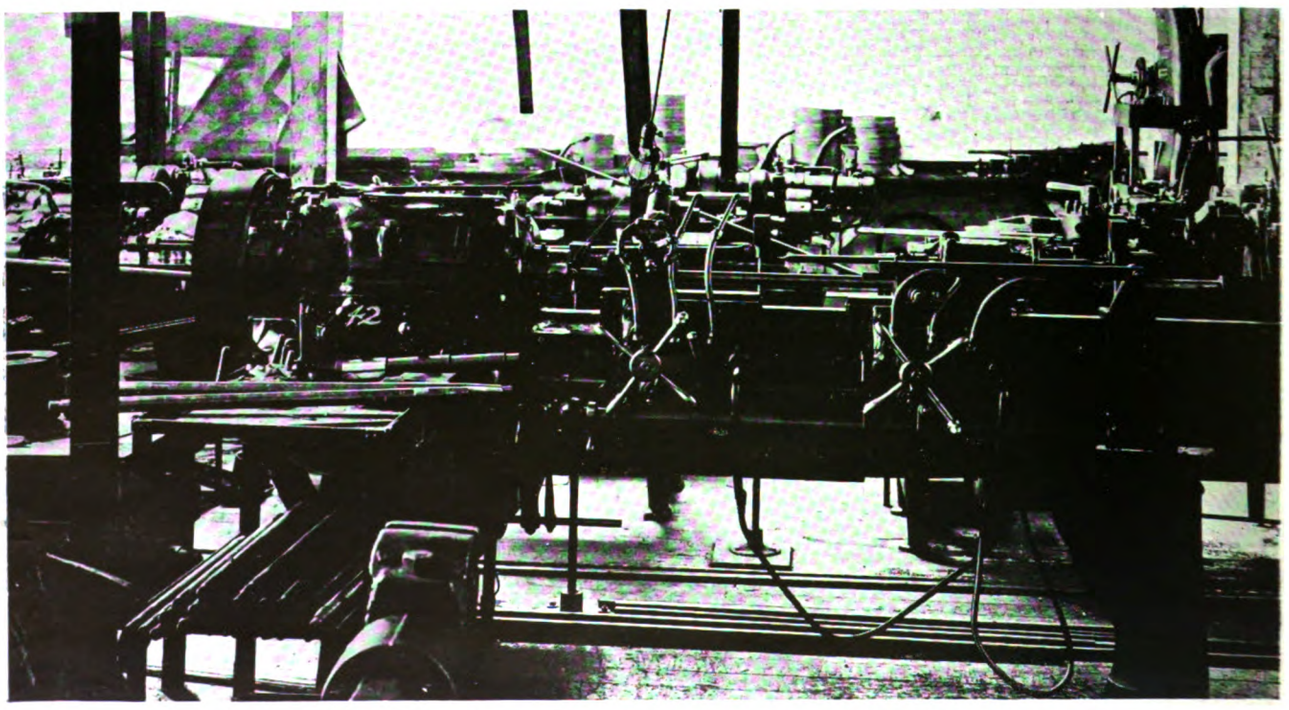

FIG. 3. LO-SWING LATHE WORKING ON AUTOMOBILE AXLES

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working on automobile axles. A taper is being turned on one end at the same time that a thread is cut near the other end of the axle. On this particular job the axles are delivered turned to size. The Lo-Swing lathe is especially suited for work of this kind, where several operations can be done on the piece at the same time.

This work is done by a machine specialist, but the set-up is made by the foreman or other skilled mechanic. The same rule is followed on most of the other repetition

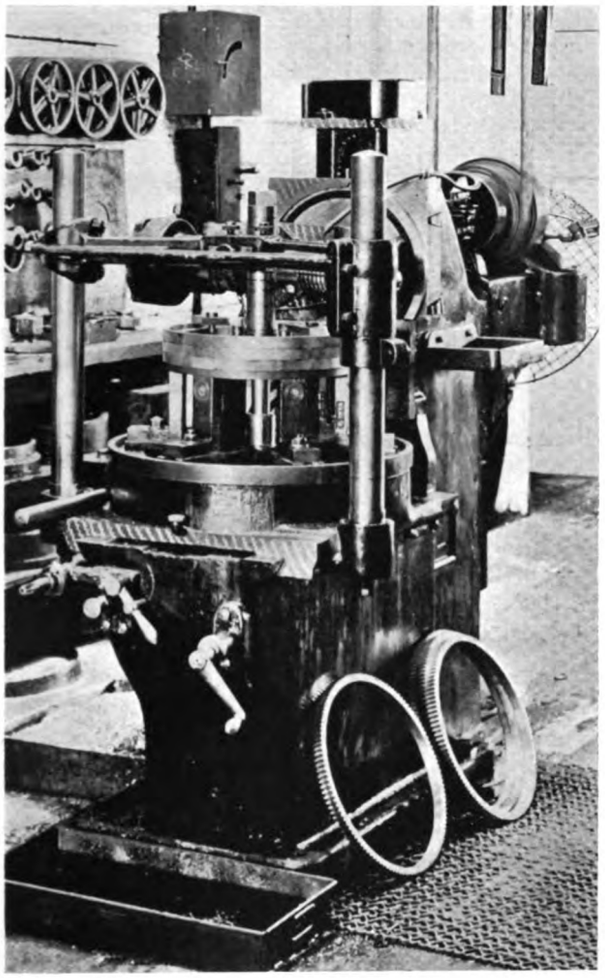

FIG. 1. HOBBING AUTOMOBILE RING-GEARS

work done in the shop, and it allows the payment of good wages and at the same time economical production is obtained.

"THE need of the hour is a new point of view upon the part of everyone—investors, managers, patrons, and public officials. The present bad condition of the street railways, like the high cost of living, is due to the fact that everyone is bent on getting something without paying for it. Everyone is thinking only of himself. Too few are trying to render real service. We all are seeking to do as little as we can and get as much as we can. We have reached the end of our rope in street-railway transportation and we shall soon reach it along some other lines. The underlying cause of our troubles today is not financial but rather moral. Only a religious revival will solve either our transportation or our cost of living problems."—Testimony of Roger W. Babson before the Federal Street Railway Commission.

BUILDING UP FOREIGN TRADE THROUGH STUDY OF SPECIAL REQUIREMENTS

The importance of a careful study of the local requirements as a prerequisite to establishing permanent foreign-trade relations is emphasized in a recent statement by E. Verne Richardson, consul at Karachi, India, appearing in 'U. S. Commerce Reports'. Mr. Richardson's remarks are particularly appropriate to the Indian market, but a general application can be made to all foreign trade.

Hitherto, a great deal of what for want of a more appropriate name has been called in the United States 'exporting', has in reality been nothing more than selling surplus or superfluous stock in markets beyond the geographical limits of the country. Many of these products, primarily manufactured for American people and American requirements, have been offered for purchase overseas on a sort of 'take it or leave it' basis. This haphazard method of foreign selling is not exporting as exporting should be understood. It is not enough to say of an article that it suits American conditions, and therefore is good enough for anybody.

In countries like India, where every European has his native servant, probably several of them, private conveyances must be provided with an extra seat for a 'boy'. This is usually at the back. Naturally, vehicles equipped in this fashion by their manufacturers are more in request than those not so equipped. An American runabout automobile at home may not, and probably does not, need this extra seat; but if India needs it and wants it, the wide-awake American manufacturer of automobiles will see that this seat is provided on the cars he sends to India. A second example: In American cities water-supply hydrants are universally installed, and a steam-roller, tractor, concrete-mixer, or other machine requiring periodical water-supply has no difficulty in filling its tank. But there are places in India where water is not thus easily available. An attachment to the tractor designed to hold a water cart is a simple matter, and if India wants this attachment, then manufacturers should provide it.

It is a matter of record in India that a German firm before the War secured a contract for a certain light railway at a price higher than that tendered by others simply because it asked the purchaser exactly what he wanted and then agreed to give it to him, notwithstanding that to do so, complete sets of new patterns had to be made for part of the work.

A successful solution of the export problem involves a knowledge of local conditions in the foreign country and a willingness to give that country what it wants.

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Gas as a Fuel for Rivet-Making and Rivet-Heating

By LETSON BALLIET*

The fallacy of deciding the value of a fuel by the b.t.u. content alone is a common error. Crude oil has 3,456,000 b.t.u. in a dollar's worth. Coke (varies) 1,604,000 b.t.u. in a dollar's work. City gas has 777,700 b.t.u. in a dollar's worth.

The scaling or burning of rivets is caused by excess of oxygen, supplied during the period of heating or permitted to come in contact with the heated rivets and not by the fuel. Fuels with high b.t.u. values are wasteful when the amount burned has a calorific value in excess of that which can be used.

It is not the high temperature, nor the high British thermal-unit value of the fuel that ensures the best, quickest, or most efficient result. It is the fuel that can be accurately controlled, under proper conditions for combustion, in a properly designed forge, burner, or furnace that gives the cheapest and most efficient results. Neither the temperature beyond that required to bring the steel to the proper condition for working (about 1900°F.) nor the b.t.u. content producing this temperature excess has any value.

It not only is a definite waste, but often, if not always, is a serious detriment, frequently entailing considerable financial loss. Most fuels can be made to produce more heat than is needed and it is much easier to handle the personal element, when you can direct or force the workman to bring the heat up to efficient operating conditions, rather than expect him to save fuel in bringing it down to efficient conditions. In bringing it up, if he gets results, you know it is efficiently handled, but if he gets results with excess b.t.u. no one ever knows whether or not he brings it down so as not to waste.

Oxidation or scaling of the rivets is one of the principal enemies to good results in any kind of riveting.

Rod-furnaces and rivet-forges as they are ordinarily operated cause scaling of the rivets.

Rod-furnaces and rivet-forges as they are ordinarily operated are oxidizing rather than reducing agents, and there is great danger of too great oxidation of the rivets as they are made originally and also while they are heated preparatory to driving.

For convenience, let us consider rivet-heating first, and the oil-fired forge. The following figures are based on experience with 15 oil-fired forges for about a year.

Fuel oil, 33 gal. at $0.04 per gal	$1.32
Compressed air, power only	1.42
Labor delivering fuel-oil	0.62
Overhead on oil deliveries, plus losses from leakage, not less than	0.06
Burnt rivets, 100 lb. at $0.07 per lb	7.00
Imperfect rivets and re-riveting, not less than	2.30
Cleaning up around forges	2.10
Furnace repair and forge upkeep	0.68
Total per forge per eight-hour shift	$15.50

General overhead, insurance, taxes, rivet-gang wages, etc., have been omitted in this comparison, as these items would be the same for all kinds of fuel. Imperfect rivets that have to be burnt out with the oxy-acetylene torch and replaced, often after the plate is in position, are an important source of expense. Foremen in welding and cutting departments of shipyards have told me that half the expense of their department is caused by mistakes in other departments, particularly the carelessness of piece-workers. The allowance for burnt rivets is moderate. I have seen as much as 328 lb. of spoiled rivets taken from a forge after one shift's work. I have seen a forge full of white-hot rivets dumped out because the riveter wanted to change the size of the rivet he was using, and the forge re-filled with the required size. Piece-workers did not pay any attention to the number of rivets lost. Their pay was based on rivets driven, not on rivets heated. Therefore they crowded the fires with all the air and oil possible, heating the rivets as fast as they could, and always being sure that they 'had plenty' in the fire, as it was better from their standpoint to scrape out ten or twenty pounds than to wait five minutes for hot rivets.

Both burnt and imperfect rivets are sources of heavy expense in the operation of oil-burning rivet-forges.

It is not practical to govern the air supply to an oil-burning forge, particularly since the air pressure on long lines from which there are other branches varies considerably. Oxidized rivets do not make a good finished job, as the scale prevents the head from coming down tight, and the neck of the rivet is held too high in the hole. Even if the rivet is not actually 'loose', it is not likely to be tight all around on account of scale at some point. From this standpoint alone, the oil-forge, as it is commonly operated, should be condemned.

Coke-burning forges are lighter than oil-burning forges, and are made to be portable, but they are also expensive. Figures based on a year's experience with 200 to 300 forges, give an average of 110 lb. of coke burned per forge per eight-hour shift. At $18 per ton this is $0.99 per forge per shift. Tests on the amount of compressed air used showed that when the rivet-heater knew the test was being made the consumption was from 28 to 33 cu. ft. per minute, but when he did not know it,

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the consumption was from 40 to 60 cu. ft. per minute. These tests were made with tight air-hose within 50 ft. of the forge, and were repeated on different days. Allowing for pipe-line leaks back of the point of measurement, and taking into consideration the mechanical efficiency of the compressors, assuming 4 cu. ft. per minute per horse-power, and 10 hp. per forge is conservative. Considering the emergency character of the construction at the shipyards it is more likely that the average was nearer 20 hp. per forge. At 10 hp. per forge, and $0.01 per kw-hr. for energy, the cost for power would be $0.60 per forge shift. The cost of delivery of the coke, of removal of the ashes, loss of rivets in ashes, burnt rivets, and a number of other disadvantages are to be considered in connection with the use of coke for heating rivets.

With both oil and coke fuel the smoke and fumes where forges are used in a confined space are objectionable, and with oil fuel there is a considerable increase in the fire hazard.

The above considerations as well as others led to the adoption of gas as fuel in some of the yards, and, while at first the conservatism of both superintendents and workmen militated against gas having a fair trial, nevertheless its advantages have been definitely proved in practice. In particular, the prophecies of explosions and injuries to men have failed to come true. On the contrary, gas has been proved to reduce both the accident hazard and the fire hazard as compared with either oil or coke.

The use of gas in rivet-forges has reduced both the accident hazard and the fire hazard as compared with oil or coke.

The gas equipment used in the shipyards is designed to mix 1.6 cu. ft. of air with each cubic foot of gas, and to distribute this mixture of gas and air, which is non-explosive, to the forges. At each forge is a Bunsen burner, adjusted to admit 3.4 cu. ft. of air to 2.6 cu. ft. of the gas-and-air mixture supplied by the pipes. This provides in all five cubic feet of air to each cubic foot of city gas, which allows complete combustion without any excess oxygen to start scaling the rivets. With this mixture established, the size of the burners, the size of the combustion-chamber, and the valve-control will determine the number of pounds of rivets that can be heated per minute. The amount of gas used will therefore vary with the work done and also with the skill of the operator. With 300 forges at work and unskilled operators, the cost of gas per forge per shift ranged between $0.30 and $1.30.

Gas heating for rivets increases the speed of riveting mainly for these reasons: The riveter has a clean place to work without stopping to sweep away ashes or wipe away spilled oil. The rivets are heated continuously with no delays, which are frequent with coke or oil. The rivets themselves are better and do not have to be set with a hammer. They slip into the holes and go down to the head easily; they are softer and easier to drive, and there is less wear on the dies. This in turn saves time lost in re-grinding dies.

Besides reducing the number of spoiled and imperfect rivets, the use of gas increases the speed of riveting.

Other advantages of gas fuel are elimination of men and trucks hauling oil or coke and cleaning up and, in comparison with oil, no delays from stoppage of the burners. There is also a large reduction in the work done by the welding and cutting departments in cutting out bad rivets, and a reduction in the amount of calking required for rivets. Taking all these conditions into consideration, a conservative estimate of the saving by the substitution of gas for either oil or coke is $6 per forge per shift.

Turning to the use of gas in making rivets, the ordinary rod-furnace is an oxidizing agent. The speed with which the rods are heated and withdrawn affects the length of the oxidizing period, so that some rivets are better than others, but some oxidizing cannot be prevented. After the rivets are made they are allowed to cool in the air, and more oxidizing takes place. Tests have shown that the loss in scale due to oxidizing ranges from 2¼% to 3½% of the weight of the rods used. In other words, a small plant, making only 16 to 18 tons of rivets per day, loses 1000 lb. of metal in scale that should have gone into rivets. At $0.07 per pound this is $70. This, however, is not the only loss. Scale gets in between the dies and prevents their coming together properly. The result of this is oversized rivets, imperfect necks and heads of rivets, and breakage and wear on the dies. An imperfect rivet causes loss of time and money all along the line until it is finally discarded after an unsuccessful attempt to drive it.

With a gas-furnace, and with the mixture adjusted so that five cubic feet of air is combined with one cubic foot of gas, non-oxidizing conditions can be maintained. The pressure inside the combustion-chamber must be a little above atmospheric to prevent any inrush of cold air either where the rods are fed into the furnace or where they are taken from it. Instead some of the burnt gases should leave the furnace at these points. The following requirements should be kept in mind in designing such furnaces:

A gas-heated rod-furnace can be run non-oxidizing, producing good rivets and eliminating the waste caused by loss of metal in scale.

The combustion-chamber must receive no excess air, and should not be larger than necessary. The interior of the combustion-chamber should be readily accessible. Making of minor repairs should be possible in a few minutes, without waiting for the interior to cool. Relining the combustion-chamber should be possible in a few hours. Temperature control should be positive and accurate, so that each rod should leave the furnace at the same fixed heat. Feeding the cold rods and the removing of the hot ones should be easy so that the work can proceed as fast as possible. The rod-exit opening should be as close as possible to the header. The burners should be adjustable, so that the amount of fuel used can be varied to suit the size of the rods. Manifestly making

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eighty 1½ by 6-in. rivets per minute requires more fuel than making ¼ by 2-in. rivets at the same rate.

The use of gas for fuel is advantageous for a number of other operations in shipyard and similar work. For pipe-bending it may be used in a pre-heating forge or with an external torch with the pipe on the block. For large pipes the torch may be inserted in the pipe. For melting, babbitt, tin, lead, or solder, or for brazing, gas has many advantages over other fuels. It may be used in pre-heating ovens, and also for flanging torches in place of acetylene. Excellent results have been obtained where it has been used for cutting-torches instead of acetylene. From 20% to 80% more gas is required as compared with acetylene, but with gas at $0.07 and acetylene at $2.50 per 100 cu. ft., there is still a considerable saving. The amount of oxygen needed appears to be actually less. My experiments indicate that the cost, exclusive of labor of cutting, with city gas and oxygen is about 20% of the cost of cutting with acetylene and oxygen. The speed of cutting is about the same, and the edge that is cut is softer when gas is used than when acetylene is used. This is important if reamers or machine-tools are to be used on the edge that is cut. Using city gas the results are as good from the standpoint of wear on machine-tools as where hydrogen is used, and the rate of cutting is faster. With plates under ⅜ in. thick, cutting with gas is about $2 per hour cheaper than cutting with acetylene. The saving increases with the thickness of the plates, being $5 per hour for 1¼-in. plates. A well-finished hole, either ¾ or ⅞ in. diam. in ½ or ¾-in. plate can be burned with gas and oxygen in 14 to 23 seconds.

Excellent results have obtained when using city gas and oxygen in place of acetylene and oxygen for cutting.

PROPOSED ASSOCIATION FOR RESEARCH IN ALLOYS

The Division of Industrial Research of the National Research Council is arranging for the formation of a co-operative association to plan and support fundamental researches in alloys. Although much valuable work has been done in this field by scattered investigators there is no doubt that a well-planned and co-ordinated effort by a co-operative association working under the general guidance of the National Research Council and composed of specialists representing both the manufacturers and the more extensive users of alloys can produce additional results of great importance as has been indicated by the success of other industries that have supported research on a co-operative plan, such as has been done by the National Canners' Association and the American Malleable Casting Association. It is planned to create a special scientific staff composed of a director and assistant director of research and a group of scientific investigators and technical experts, who shall give their whole time to the work. To finance the organization, each member of the co-operative association will pay $1000 per year, and all contributing members, who may be either alloy-manufacturing or alloy-using individuals, firms, or companies are to benefit alike by the results of the researches.

WAR STORY OF THE AMERICAN RED CROSS TOLD IN ROUND FIGURES

Contributions received (material and money)	$400,000,000
Red Cross members: adults, 20,000,000; children, 11,000,000	31,000,000
Red Cross workers	8,100,000
Relief articles produced by volunteer workers	371,577,000
Families of soldiers aided by home service in United States	500,000
Refreshments served by canteen workers in United States	40,000,000
Nurses enrolled for service with Army, Navy, or Red Cross	23,822
Kinds of comfort articles distributed to soldiers and sailors in United States	2,700
Knitted articles given to soldiers and sailors in United States	10,900,000
Tons of relief supplies shipped overseas	101,000
Patient days for soldiers and sailors in Red Cross hospitals in France	1,155,000
French hospitals given material aid	3,780
Splints supplied American soldiers	294,000
Gallons of nitrous oxide and oxygen furnished French hospitals in France	4,340,000
Soldiers served by Red Cross canteens in France	15,376,000

THE morning report is a fearsome document. On it appear all the changes in status of men and animals for each preceding twenty-four hours. It happened once in an Ohio regiment that two mules fell ill one night. The veterinarian gave his verdict of hopeless, and the captain of the supply company accordingly made the proper entry on the morning report: "Two mules, from duty to dead."

But under the care of the grizzled old stable-sergeant the mules recovered and next morning the captain found them alive and kicking. Now, entries made on the morning report can never be erased, which made the situation embarrassing for the captain. However, he was a man of resource, and the next day's report carried the startling entry: "Two mules, from dead to duty."

LIGHTS and noise were taboo, but there was some verbal expression of thought in undertones. The column was slogging forward the night before the attack on the St. Mihiel salient.

"Wonder where we're bound for now?" spoke one doughboy during a momentary check.

"I dunno," replied a voice in the dark, "but I heard an officer say it was Metz."

"Huh! Metz?"

"Sure—and he said the general meant to take it if it cost 100,000 lives."

Silence for about five seconds; then—"Liberal son of a gun, ain't he?"—Home Sector.

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The Locomotive-Crane From the Safety Standpoint

In an address delivered at the recent meeting of the National Safety Council, Chester C. Rausch, assistant director of the Safety Institute of America, called attention to the fact that the locomotive-crane is coming to be one of the most common types in use, both in shops and in yards. Unlike the overhead traveling-crane, it is not confined to definite limits of operation within a building or over a given yard-space but, because of its mobility, it operates equally well within a shop or about a yard. This flexibility of operation reduces materially the number of times that a piece of equipment must be handled. Moreover, the boom enables the crane to reach places an overhead crane could not. The locomotive-crane is a rather recent development and while its hazards are easily comprehended, there are not as many men available that are skilful in handling this type of crane as there are of other types.

Not as many men are skilful in handling locomotive-cranes as there are of the other kind.

One of the main sources of hazard is failure to maintain the road-bed over which the crane must travel. Frequently, in an effort at economy, light weight or partly decayed ties and second-hand, defective, or light rails have been used, giving an inconvenient and unsafe road-bed. Failure to keep the road-bed properly tamped and drained allows it to settle and become uneven so that the crane does not travel steadily and is likely to overturn. The use of improper frogs, cross-overs and switches, and the failure to keep them in repair, increase this hazard. Such a road-bed throws numerous strains into the structure of a moving crane by the swinging motion imparted to the load suspended from the boom. This condition sometimes becomes aggravated to a point where collision of the suspended objects may occur with other railroad property or with structures in the yards adjacent to the track upon which the crane travels. This distracts the engineer's attention so that collisions with pedestrians, trucks, and teams are more likely to occur.

Failure to maintain the road-bed over which the crane must travel is one of the main sources of hazard.

When locomotive-crane track-ways are placed too near buildings, especially on curves, the entire attention of the engineer is often required to prevent collision with buildings. With cranes that are capable of considerable speed damage is frequent. Where the crane is large, both in lifting capacity and range of boom and the enginer's cab is located some distance above the ground, this hazard is particularly acute.

Overturning is frequent with locomotive-cranes. In the smaller sizes the wheel base is short. Often the boom is swung with loads beyond the safe capacity provided the angle of elevation is increased, and consequently the crane is tipped on its side when this angle is increased ever so little as a result of even slight inequalities in the road-bed. Even when traveling on a straight track under these conditions and with the boom-axis parallel to the axis of the track, slight obstructions on the rail are sufficient to cause disaster because the crane is working practically at its ultimate capacity and its points of safe balance.

Another difficulty is the inability of the operator to maintain a clear view both ahead and behind his crane while traveling. Inability to see toward the rear when the crane is moving forward frequently causes injury to people when the crane is turned on its table or else may cause people or objects to be run over when the crane moves in that direction. Reflecting mirrors, similar to those used on automobiles, tend to eliminate this difficulty, provided the mirrors are adjusted carefully and are of sufficient size to afford ample view. In some cranes small windows have been placed low down in the rear of the crane and the storage-tanks and coal-pockets altered to permit the use of peekholes through which the engineer while standing in his usual place and turning his head can see behind the crane. Even when alarm-bells or gongs are used, the engineer cannot be certain if he cannot see the track that an accident is not imminent to material or persons.

Whenever a crane overturns, unusual strains are placed on the boiler and steam-piping. Engineers, even if they escape scalding or injury when the crane overturns, may be penned in and seriously burned unless the doors and windows are arranged to open outward and are provided with fasteners operating from both the inside and the outside.

Frequently the original structure of the crane, particularly the boom, is changed; lengthened to increase its range, strengthened to increase its capacity for lifting. Lengthening the boom reduces the capacity of the crane safely to handle loads at a given elevation and an increase of the cable size and strength or an increase of the steam-pressure to permit the lifting of heavier loads at greater boom-elevations introduces strains that frequently cause collapse. The failure of many crane engineers to recognize the reduction in the safe capacity of the crane caused by any change in elevation has caused the collapse of many booms.

Changes made in the original structure of the crane are frequently a source of danger.

Many operators overload cranes and take a chance

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that the crane can handle the load. This tendency is fostered by the fact that the crane is not under the observation of a single foreman but moves from place to place in charge of its operator. While such acts are matters of discipline, there are several devices that can be attached to cranes to indicate when the crane is at the point of overturning and to give audible warning beforehand. The best devices of this sort are placed in the cab of the engineer and are frequently supplemented by an indicator placed on the boom which shows, by means of a pointer, the safe load that may be handled for any given boom-elevation. This indicator may also indicate safe overhead clearances for the boom. It is not safe to depend on the tables of safe boom-elevations for given loads frequently placed on plates attached to the frame of the crane or in the cab because these tables require personal estimation of conditions by the operator.

Several devices are made, which, when attached to cranes, indicate when a crane is at the point of overturning and give audible warning.

Locomotive-cranes are frequently poorly illuminated even when they perform their work in places where the operator has no adequate opportunity to see clearly the work he is doing. The placing of several storage-battery cells on such a crane provides current for adequate light in the interior of the cab for firing and for illuminating the gauges and particularly for a spot-light that can be controlled by the engineer and thrown upon the objects he is handling. Very frequently a light placed on the tip of the boom, and arranged to throw its rays vertically downward, has been found of advantage. Whenever cranes work at night, consideration should be given to these points.

The work done by locomotive-cranes is nearly always conducted out of doors, but little attempt is made to house or to protect them from the elements. As a result rust, with all its attendant and subtle hazards, attacks the machine in various places, the cables particularly. Proper painting should be given at frequent intervals, adequate lubrication provided, and the boiler should have regular inspection. Improper feed-water may cause trouble enough to put the crane out of commission.

In the operation of such cranes, dependence is frequently placed upon lowering the load and swinging the boom to throw an object upon storage-piles or into a position that cannot be reached by the crane when in its ultimate safe position for such a load. Dependence is placed upon the element of time to permit the load to swing into its final place before it can tip the crane far enough to cause it to overturn or leave the rails. Any failure of judgment on the part of the operator is fatal.

NEW CHINESE STEEL PLANT

The Ho Hsin Smelting Works, a new plant at Pootung near Shanghai, has commenced operations. Its capital is 500,000 taels (approximately $550,000). The plant is half completed, and the smelting department is in operation. The daily output is 10 tons of pig-iron, and it is expected that this will be increased to 40 tons eventually. The managing director is Lu Pei Ling, who is also the manager for the Nantao Tramway Co. The plant is supervised by one foreign superintendent and one chemist, and 300 laborers are employed. Raw material is procured from Wuhu, and the finished product is sold in China and Japan.

SIAM'S TRADE IN METAL GOODS

Most of Siam's imports of iron and steel manufactures have hitherto come from European countries, but during the last few years the United States' share in this trade has advanced considerably, amounting to $345,015 worth of metal manufactures and $89,781 worth of machinery in the fiscal year 1917-'18, as compared with $22,196 and $22,046, respectively, in the pre-war fiscal year ended March 31, 1914.

Lack of direct shipping facilities between Siam and the United States has hindered greatly the progress of reciprocal trade relations between the respective countries. However, besides the actual consignments by foreign ships, many American products have found their way to Siam through trans-shipments, so that articles of all sorts manufactured in the United States may be seen in every part of Siam; but in order to push business, American distributing houses are essential, and there are at present only two or three of these in the entire country.

The aggregate declared value of the imports of machinery through the port of Bangkok was $754,611 in the fiscal year ended March 31, 1914; $538,294 in 1915; $457,712 in 1916; $521,611 in 1917; and $293,145 in 1918. Among the more important items in the machinery imports were marine engines, rice-milling machinery, sewing machines, railway locomotives, and machine tools. The total value of the imports of all metal manufactures, other than machinery, amounted to $2,262,364 in the fiscal year 1913-'14; $1,731,694 in 1914-'15; $1,492,276 in 1915-'16; $1,638,835 in 1916-'17; and $1,368,341 in 1917-'18. The cutlery and tool imports, not including machine tools, are classified separately, the value of the shipments of the former being $57,253 in the fiscal year 1916-'17 and $96,489 in 1917-'18; and of the latter $214,249 and $141,689 in 1916-'17 and 1917-'18, respectively.

The import duty on all kinds of metal products is 3% ad valorem and is levied on the entire cost of the shipment, including packing, freight, insurance, and all other charges to the port of landing. Practically all the shipments from foreign countries to Siam are landed at Bangkok, which is the most important port, and is also the centre for distribution, by rail and waterways, of merchandise to all parts of the country. Most of the Bangkok firms are general importers, and handle metal products of all kinds.

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Pyrometry in the Steel Industry*

By RICHARD P. BROWN†

The old methods of measuring temperature by the expansion or fusing points of clay, by the expansion or contraction of metals, and by numerous other methods, have largely been eliminated today and we have practically only two methods of measuring high temperatures. The thermo-electric pyrometer requires either a thermo-couple inserted directly in the heat, or else it is in the form of a radiation pyrometer with the thermo-couple heated by the furnace rays; while in the optical pyrometer a color comparison of an incandescent body and the steel under treatment is made. The optical pyrometer is used only as a portable instrument, as it is not suitable for permanent installation or for automatically recording temperature. It is used extensively where it is necessary to focus on a particular piece of steel in a furnace to secure its temperature, or where excessively high temperatures are measured, around 3000°F., where a thermo-electric pyrometer is not suitable because of the effect of the temperature on the thermo-couple metals.

The optical pyrometer as generally used, compares the incandescent filament of an electric-lamp bulb with the luminosity of the metal under treatment. A milli-ammeter is used to measure the current passing through the lamp; the more current, the brighter the filament and the greater the number of milli-amperes indicated on the meter. By turning a rheostat, the amount of current passing through the lamp can be adjusted. When the color of the lamp-filament blends with the piece of steel under treatment it is assumed that the two are at the same temperature. The reading on the milli-ammeter is taken, and the temperature determined from a conversion table. Other forms of optical pyrometers compare the flame of a small oil or kerosene lamp or the color of a multi-colored lens with the steel that is being heat-treated. Optical pyrometers have so far had a relatively small field, and they will not be further discussed in this paper.

A thermo-electric pyrometer consists of a thermo-couple, a measuring instrument, and the leads connecting the thermo-couple and the meter. The thermo-couple is formed of two dissimilar metals, usually drawn into wire and with one pair of ends twisted together. When this junction is heated, it generates a small current of electricity, which can be measured on a millivolt-meter. A thermo-couple produces current, dependent on the difference of temperature of the twisted junction extending into the furnace, known as the hot end, and the opposite end outside the furnace, known as the cold end or cold junction. It is at these ends that the leads running to the meter are joined to the thermo-couple. In measuring temperature accurately with a thermo-couple it is, therefore, essential that the cold junction be maintained at a known fixed temperature. If the cold junction of a thermo-couple is at 75°F. and the hot junction in the furnace is at 1400°F., the actual millivoltage generated is produced by the difference in temperature between the hot end and the cold end of the thermo-couple, equivalent to 1325°F. If we heat this cold junction to 100°F. we will then have a millivoltage produced by the thermo-couple corresponding to the difference in temperature of 1300°F. instead of 1325°F., as previously cited. The effect of heating the cold junction of a base-metal thermo-couple is such that with a rise in temperature of the cold junction of 25°F. the instrument will read approximately 25° low. With a platinum thermo-couple this error is approximately one-half the error for a base-metal couple.

In measuring temperatures accurately with a thermo-couple, it is essential that the cold junction be maintained at a known fixed temperature.

In the use of any thermo-electric pyrometer it is essential that this fact be realized, because far too many thermo-electric pyrometers are in use today with the cold junction of the thermo-couple placed right above a furnace and subject to constant changes in temperature and probably to a normal temperature of not less than 200°F. Assuming that the pointer on the instrument is set at 75°F., such an instrument is actually reading 125° too low. Of course, if the user of the instrument realizes this fact, he will set the pointer of his instrument for the proper cold-junction temperature, 200°F., instead of that usually adopted in supplying the pyrometer, 75°F. All modern pyrometers are equipped with zero adjusters, which permit setting the pointer to any desired cold-junction temperature. Unfortunately where a thermo-couple is just above the furnace, soon after the furnace is started, the temperature of the thermo-couple inside might be 1400°F. and the cold junction outside might have reached only 100°F. After the furnace has been run six hours, the heat radiation from the crown of the furnace may be such that the cold-junction temperature will reach 200°F. The pyrometer, then, is reading 100° lower than it did before for exactly the same temperature in the furnace. In consequence, the operator in order to make the pyrometer read the desired temperature, 1400°F., is actually carrying 1500°F. in the furnace.

There are a number of ways to overcome this source of error from changes in temperature of the cold junction

*Abstract of paper read at the Convention of the American Steel Treater's Society.

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of the thermo-couple. First, we can supply compensating-leads, as they are called, consisting of material the same as that forming the thermo-couple, which will remove the cold junction to some distant point where the temperature will be constant. These compensating-leads can be selected of material the same as the thermo-couples or of the other alloys that will offset the effect of change in temperature at the cold end of the thermo-couple. If we run these compensating-leads to some point near the floor in the heat-treating room, the temperature will probably vary from 60° to 110°F. from winter to summer, or a possible error of 50°F. where a base-metal thermo-couple is used.

There are several ways by which we can further reduce this possible error. First, we can run the compensating-leads into a pipe driven into the ground for some 10 ft. and at the bottom of this pipe we can make our junction with the copper leads running to the instrument. The cold junction is now in the ground where the change from winter to summer under usual conditions is not more than 5°F. With this method it is desirable to use two pipes, the outer and larger one welded to a point at the end to drive easily into the ground. The inner pipe welded tight at the end can be slipped into the outer pipe. It is possible to split the outer pipe in driving and, in consequence, water may enter. By using a second interior pipe, this pipe can be slipped in the larger outer pipe so that it is not under any strain in driving and can be easily made water-tight. The compensating-leads for placing in the ground should have moisture-proof insulation to prevent any danger of short circuiting or grounding on account of moisture. Where these precautions are taken, this is an excellent method of maintaining a constant cold-junction temperature.

Another common method is to place the cold end of the compensating leads in a compensating-box, which consists of a thermostat and lamps or heating units. By means of the thermostat it is possible to maintain any desired temperature, usually up to 150°F., within a limit of + or -2°F. The ordinary compensating-box is designed to take care of as many as 20 thermo-couples. In using the compensating-box, it is essential that the thermostat be set with the graduated temperature scale at a temperature higher than that which will be attained in the room in which the compensating-box is placed; for example, if the room will attain a maximum temperature in summer of 120°F., it is common practice to set the compensating-box at 125°F., and the pointer on the scale of the pyrometers that are operated by the various thermo-couples connected through this compensating-box will be set likewise for 125°F. on the scale. This prevents the temperature of the room exceeding that in the box.

Thermo-electric pyrometers are now supplied with automatic compensating means at the instrument so that, provided the compensating-leads are run to the instrument, automatic compensation takes place to overcome changes in temperature at the instrument itself. This compensation can be readily incorporated in the thermo-electric pyrometers through a shunt of large temperature co-efficient, which will be materially affected with atmospheric changes in temperature.

I have referred previously to the use of thermo-couples formed of base metal and of platinum wire. Base-metal thermo-couples are almost universally used for measuring temperatures to 2000°F. For temperatures up to 1200°F. these couples are usually formed with one wire of constantan, a nickel-copper alloy, and the other of a pure iron. This form of thermo-couple is advantageous for use in a reducing atmosphere within the above temperature limits. For temperatures above 1200°F. up to 2000°F., a couple formed of one wire of 90% nickel and 10% chrome and another wire of 98% nickel with the remainder manganese, silicon, and aluminum gives the most satisfactory service.

Base-metal thermo-couples are almost universally used for temperatures up to 2000°F.

When we have to measure temperatures from 2000°F. to a maximum of 3000°F., it is best to use a platinum-rhodium thermo-couple, one wire being of pure platinum and the other platinum 90% and rhodium 10%. A platinum-rhodium thermo-couple gives satisfactory life even under severe service at temperatures up to 2500 and 2600°F., provided the wires are suitably protected from the gases with a tube of porcelain or silica, which is impervious to gases. These tubes are in turn protected with a tube of graphite, carborundum, firebrick, or other suitable material, which serves to protect the fragile porcelain or silica tube from mechanical injury and introduces a slight lag to prevent breakage through contraction and expansion due to sudden changes in temperature.

For temperatures above 2000° and up to a maximum of 3000°F. a platinum-rhodium thermo-couple should be used.

While it is of the utmost importance to protect properly a platinum-rhodium thermo-couple in order to exclude gases that attack the platinum, it is equally desirable to protect a base-metal thermo-couple if maximum life is to be secured. The usual method of protecting a thermo-couple for temperatures up to 1400°F. is to use a common wrought-iron pipe with the lower end plugged or welded. The life of such pipe can be increased somewhat by calorizing, a process of impregnating the pipe with an aluminum oxide developed by the General Electric Co. A material increase in the life of base-metal thermo-couples for temperatures above 1400°F. is secured by the use of protecting tubes of nickel-chromium or of a special alloy that we have recently adopted in our 'Resisteat' tubes, as they are trade-marked. The nickel-chromium tubes withstand normal use in heat-treating furnaces where the temperature does not exceed 1600°F., but for the most common conditions and where maximum life is secured this special alloy 'Resisteat' tube is given the best results.

To insulate the wires forming a thermo-couple from each other and from the protecting tube, it is common practice to use beads of porcelain or lavite, which are the most satisfactory for this service. Formerly asbestos tub-

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ing or string was used to insulate each wire and this was painted with a solution of sodium silicate and carborundum, but this form of insulation rapidly disintegrates at temperatures above 1000°F.

Automatic signaling pyrometers have been used for some years in the larger heat-treating plants where it is desirable that the operator should not decide whether the temperature is correct or not, but should be signaled by lights as to whether the temperature is within the correct limits. For some years it has been common practice to install a central indicating pyrometer with switchboard, and by means of three colored lights at each furnace, usually red, white, and green, to signal from the central station whether the temperature is too low, correct, or too high. Usually 25°F. is considered a limit within which the temperature should be maintained. The white light burns when the temperature is correct. If the temperature drops below, the green light, or if it rises above the desired temperature the red light burns. The operator of the furnace does not have to know how to read a temperature-scale; all he need be instructed is to keep the white light burning and what he is to do when the red or green light burns. Incorporated with this system is usually a signaling system to indicate when the steel is to be removed from the furnace, where a definite time interval for heat-treatment has been determined.

A step farther is the automatic signaling of the temperature by an automatic signaling pyrometer which can be incorporated in the standard form of millivolt-meter pyrometer. Instead of the pointer being depressed on a record-chart as in the recording instrument, it may be depressed on contact-plates representing the correct temperature, too high, and too low. By incorporating with such an instrument a switching mechanism, a number of thermo-couples can be connected to a single indicating instrument and as many as twelve or more thermo-couples can be connected to one signaling pyrometer, which will automatically operate the lights at the furnace.

The day when furnace temperatures will be controlled automatically is coming, and notable progress has been made in this respect during the last few years.

The application of automatic-control pyrometers to electric furnaces is a comparatively easy problem, as automatic switches can be easily operated by a solenoid, which can in turn be operated by the same contact-device in the pyrometer as is used in the signaling instrument. We have applied automatic temperature-control to electric furnaces successfully and to my knowledge some 100 electric furnaces are being controlled automatically at present. This control may be secured by the opening and closing of the main circuit or line, or by cutting in and out a small part of the available current, which is possible through cutting in and out of rheostats. In this way the fluctuation in current is materially reduced as compared with opening and closing the main circuit.

Automatic control of the rate at which a furnace is being heated is also being developed.

Automatic control of gas-fired furnaces is a little more difficult, as a gas-valve, to be tight and not leak under continual operation, must be well packed, and considerable power is, therefore, required to operate the valve. We have, however, by the use of powerful solenoids or by motor-operated valves, been able to overcome this, and we have a number of gas-fired furnaces of large dimensions which are automatically controlled.

There is no question in my mind but that within the next year or two the automatic control of furnace-temperatures will be generally adopted wherever a constant temperature is to be maintained and it is desirable to eliminate the human element and hand-control. We have developed a special type of automatic-control pyrometer which can be connected to almost any number of furnaces. It was necessary to add the required switching mechanism to connect the various thermo-couples to the instrument and also to connect simultaneously the various electrically operated valves or switches. Another step, and we have already developed an instrument of this character, for which patent-application has been made, is an instrument in which the contact-table carrying the high and low contacts, is moved along the temperature scale by clock-mechanism at any desired rate of speed, so that where a furnace must heat at any given rate, this can be accomplished automatically. Assume, for example, that a large annealing furnace should attain a temperature of 1600°F. in 24 hours. The clock-mechanism advances the contact-table across the scale to 1600°F. in the period of 24 hours, and when this temperature is attained, the current can be automatically shut off if desired, opening the switches for an electric furnace or closing the valves if a gas furnace is used.

Within the next year or two the automatic control of furnace-temperature will be generally adopted wherever a constant temperature is to be maintained.

The problem that has offered a little difficulty, but which we seem to be rapidly solving, is the automatic control of oil-fired furnaces, as the oil-burners usually operate under high pressure and the burner may become clogged, which will be noticed if an operator is available, but offers difficulty with automatic temperature-control. I feel that we are rapidly reaching a point when this difficulty will be solved by securing an automatically-operated burner that is fool-proof and will not clog.

If you install pyrometers, take the time to make a little study of how the instruments operate, how they can be best installed, and how they are to be maintained after they are in use in your plant. If you have a number of furnaces place a man in charge of the instruments that has first obtained by instruction the information anyone should have to handle such a job. Do not take an office-boy to look after your pyrometer equipment. A first-class pyrometer equipment will pay for itself time after time during the year, provided, first, that it is properly designed to meet the conditions; second, that it is properly installed; third, that it is understood and maintained.

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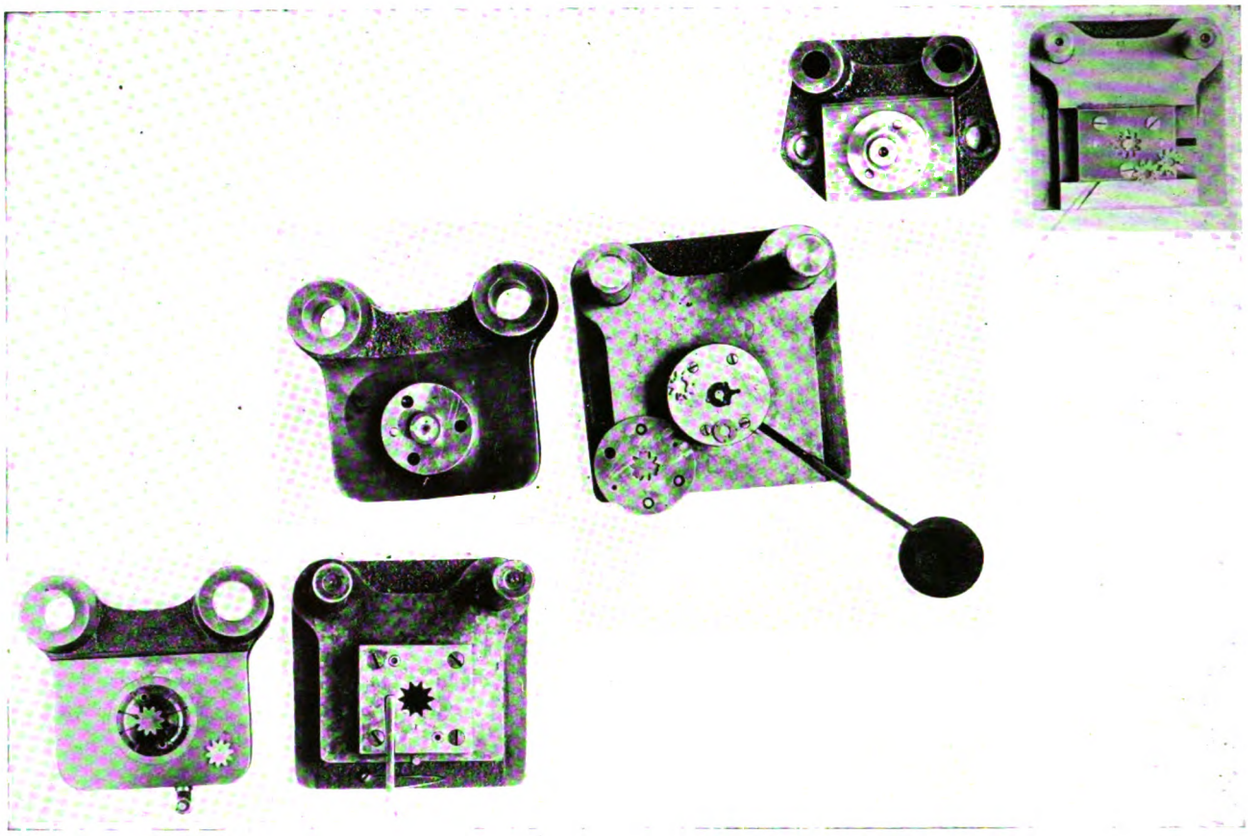

DIES FOR MAKING GEAR-WHEEL

Some Dies and Punches Used by the Marchant Calculating Machine Company

The accompanying illustrations show some of the dies and punches made in the tool department of the Marchant Calculating Machine Co. at Emeryville, and used in the manufacture of a gear-wheel for the company's multiplying machine. This particular wheel is used on each of the numbered wheels that indicate the multiplier on the machine. The first picture shows the blanking-die and punch which forms the gear blanks from a strip of steel. From this die the blanks are put through three shaving-dies similar in construction to the banking-die, bringing the blanks to size. The shaving-die takes a cut of approximately 0.002 in. The second picture shows the equipment for piercing the small holes by which the gear-wheel is fastened to the numbered wheel. The gear-wheel is 0.078 in. thick and the holes are 0.054 in. diam. They are punched without any difficulty, in spite of the general belief that it is not practical to punch holes of a diameter less than the thickness of the piece. The third illustration shows the punch and dies for forming a cam. This cam is for the purpose of transferring the motion from the particular wheel to the wheel to the left of it so that ten movements on, say, the unit-wheel give one movement of the ten-wheel. This cam was formerly made in one piece and riveted to the wheel. Now it is punched out of the metal of the wheel and milled to shape. By the old process it was impossible for an operator to make as many as 1000 cams per day. Now 10,000 are punched in the same time. The punches for piercing the small holes and forming the cam are fitted with spring-pads, which hold the work and guide the punch. Without these pads there would be a great deal of breakage in such small punches.

Special care is taken in heat-treating the punches. They are heated to 1450°F. over a gas flame, and water-quenched. They are then polished and the temper drawn to a straw color on a hot plate and quenched. This operation is repeated three times. The two extra drawings make a great improvement in the quality of the punches, giving far better wearing qualities than are found in the punches that are drawn only once. Frequently 30,000 holes are made with the punches that are drawn three times, before they require re-sharpening. A punch that

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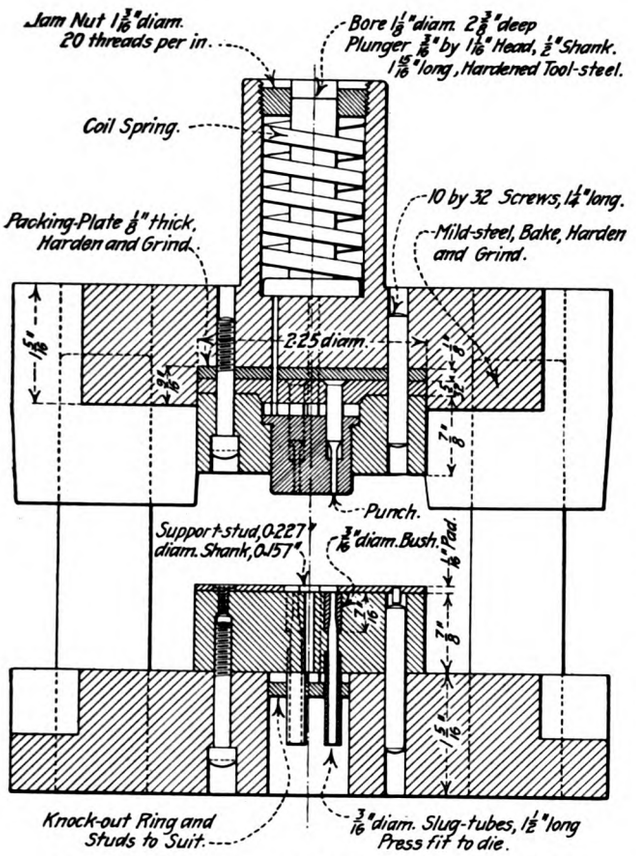

CROSS-SECTION OF PUNCH, SHOWING SPRING-PAD

has been drawn only once will seldom make more than a few hundred holes. The punches are made from 0.015 to 0.020 in. oversize to allow for possible warping during tempering and then ground to size after they have been tempered.

Grinding Track Links for the 'Caterpillar' Tractor

The links for the tread of the Holt tractors are steel castings containing about 0.35% carbon. These are obtained mainly from the Warman Steel Castings Co. of Los Angeles and the Monarch Foundry Co. of Stockton. When received at the Holt plant they are not finished, and the first operation is to grind the tread true.

The links are placed as shown in Fig. 1 on a Gardner disc grinder, made by Gardner Machine Co. of Beloit, Wisconsin. Originally, the grinders were equipped with carborundum paper having only a relatively thin coating of carborundum glued upon it. Better results are now obtained, however, by the use of paper coated with about $\frac{1}{4}$ in. of carborundum. This is built up with cement like an emery-wheel. To prevent this carborundum surface from getting out of true as it wears, a truing device mounted on a stationary steel bar extending straight across the grinding-circle is used. The device can be shifted along the bar so as to reach any part of the grinding surface. When not in use the device is raised to clear the grinding-surface entirely.

The advantage of this change in method is shown by the fact that the grinder in the foreground of Fig. 1, equipped with the heavy carborundum discs, grinds 150 links per day, while the grinder in the background, which, at the time the photograph was taken, was still equipped with the thin carborundum paper, only finished 100 links per day. In addition, the heavy carborundum disks wear seven times as long as the thin paper.

Besides the links, the grinders are used for finishing other castings where a flat true surface is required. One man operates both grinders.

The truing device was first suggested to the company by H. P. Phillips, of the Meese & Gottfried Company.

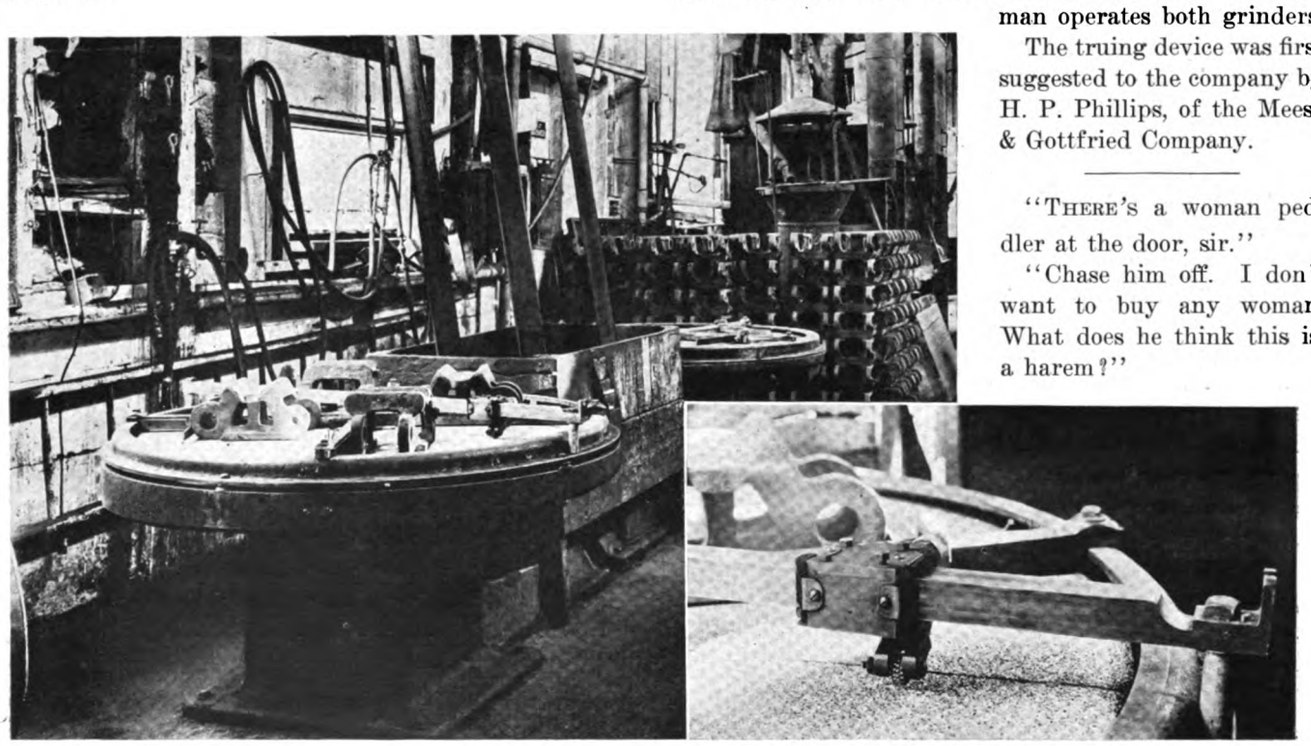

FIG. 1 AND 2. DISC-GRINDER AND NEAR VIEW OF TRUING-DEVICE

"THERE'S a woman peddler at the door, sir."

"Chase him off. I don't want to buy any woman. What does he think this is, a harem?"

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New Requirements for Aeroplanes

The British government has announced a competition, which shall have for its object "to obtain a real advance in the efficiency and design of aeroplanes and seaplanes, more especially with the view of increasing the safety of air travel". Although, as will be seen below, the competition is limited to machines designed and constructed within the British Empire, the conditions of the competition are interesting as illustrating what requirements it is now reasonable to expect an aeroplane to fulfil. The rules are as follows:

1. A competition will be held beginning March 1, 1920, with the object of ascertaining the best types of aeroplanes, which will be safe to travel in, and, in particular, be capable of alighting in, and arising from, a small space.

2. Two types of aeroplanes will be entered for the competition, (*a*) small type, with a carrying capacity of two persons, including pilot, and (*b*) large type, with seating accommodations for 15 persons, exclusive of crew.

3. Machines and engines must have been designed and constructed within the British Empire. This rule will not, however, apply in the case of such secondary equipment as ignition system, carbureters, and instruments.

4. Machines are to fulfil all conditions required for a certificate of air-worthiness, and are to carry parachutes for all persons for whom accommodation is provided, including crew.

5. Each machine must be capable of flying level at or above the following speeds with full load at ground-level: Small type, 100 miles per hour; large type, 90 miles per hour, and must also be capable of flying level at or below the following speeds with full load at ground-level; Small type, 40 miles per hour; large type, 45 miles per hour.

Each machine must also be capable of climbing not less than 500 ft. in the first minute, starting from ground-level for the small type, and 350 ft. in the first minute, starting from ground-level, for the large type.

6. (*a*) A circle will be marked on open ground to represent a field surrounded by obstacles. This circle will be of the following diameter: small machines, 175 yards; large machines, 275 yards. The obstacles will be represented by a continuous string or tape with streamers attached, 50 ft. from the ground, of such a nature as to be easily broken by an aeroplane.

(*b*) The landing to be made in still air. Still air includes any wind not exceeding 5 miles per hour at ground-level.

(*c*) During landing the machine is not to side slip nor to turn, after reaching the obstacles, until it is on the ground. Once it has touched the ground, the machine may turn in any direction.

(*d*) The machine to come to a standstill before reaching the marks representing the boundary of the field.

(*e*) After landing, the machine to go out of the same field over the 50-ft. obstacle in still air as defined in subparagraph (*b*), no turn to be allowed until clear of the obstacle on the far side.

(*f*) No braking device operated by the engine may be used during landing.

(*g*) Any landing or taking-off gear must be integral with the machine.

(*h*) No landing apparatus may be used that in the opinion of the judges would be likely to cause undue damages to an airdrome, for instance, a claw attached to the machine, as used on certain types of German machines, would not be allowed, but the ordinary knife-edge on a tail-skid would be allowed.

(*j*) Both landing and taking off to be with full load.

(*k*) Each machine will be allowed two trial attempts (which are not to be counted as tests) and thereafter will be allowed four attempts, of which two must be successful.

7. (*a*) In the case of the small type, each machine must carry out a series of two flights of 3½ hours each at a speed through the air of not less than 80 miles per hour, starting with full load. Between flights, machines will be left untouched, and under seal, if necessary, a period of not more than 50 minutes being allowed before the second flight for the purpose of filling and for normal examination. No parts of the machine to be adjusted or changed without permission from the judges.

(*b*) In the case of the large type, each machine must carry out one flight of seven hours' duration at a speed through the air of not less than 75 miles per hour, starting with full load. Pilots may be changed during these flights.

8. Machines must be capable of landing from a height of 500 ft. with their engines switched off or completely throttled.

9. In a machine having two or more engines, the stoppage or retardation of any one engine must not prevent the machine from flying level nor cause it to get out of control.

10. Machines must be capable of being started from the cockpit or cabin without undue muscular exertion on the part of the pilot.

11. Machines to be capable of flying at cruising speed for five minutes without the use of any controls or stabilizing devices. Controls may be locked during this test.

12. Machines to be capable of standing unattended and not fastened down in a wind of 10 miles per hour, blowing in any direction with reference to the machine.

13. The design of the machine to be such that the risk of the machines turning over on a rough ground is reduced to a minimum.

14. Each machine to be provided with a complete outfit for pegging it out in the open. This outfit will not be carried as part of the load during tests.

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15. In order to be eligible for prizes, machines must fulfil the conditions and tests laid down in rules 3 to 14, inclusive.

16. 'Soundness and quality of construction' will include:

(*a*) Fire protection, including use of self-sealing tanks, position of tanks (from the point of view of safety from fire in event of a crash); fire-fighting appliances and accessibility of same.

(*b*) Reliability of gasoline, oil, and water system, and facilities for seeing if all tanks are full.

(*c*) Durability of machine, including propeller (any advantages due to metal construction may be taken into account).

(*d*) Simplicity of design and accessibility of parts.

(*e*) Absence of vibration in the machine.

17. 'General features' will include:

(*a*) Efficiency and ease of control.

(*b*) Unrestricted field of view to the front for the pilot.

(*c*) Silence, as affecting occupants of the machine.

(*d*) Comfort generally, including warmth.

(*e*) Self-starting devices.

(*f*) Method of wind-screening adopted.

(*g*) Convenience for use of instruments.

(*h*) Freedom of entry and exit for occupants.

The Government will, if the entrant agrees, buy the machine of each type winning the first prize, the design to remain the property of the manufacturers. The maximum prices payable under this head will be: Small type, $20,000; large type, $50,000.

A separate competition will also be held under similar conditions for float or boat seaplanes. Each machine entered is to have seating accommodations for four persons, exclusive of the crew. There are special landing and mooring tests and conditions to be fulfilled on the water, but generally the objects of the competition are the same.

INDUSTRIAL PHYSIOLOGY

In an article appearing in 'Public Health Reports,' issued by the U. S. Public Health Service, Frederic S. Lee, professor of physiology at Columbia University, discusses what he calls the new science of industrial physiology, which deals with the working of the human mechanism in industrial activity, and includes psychological as well as physiological phenomena. Some of the conclusions reached by investigators are summarized as follows:

Certain physiological and psychological tests have been employed with workers, and it appears practicable to use some of these tests in selecting workers and assigning them to their jobs.

The output of the successive hours of the working-day in different types of operations has been measured, and curves of the output have been platted. These vary with the kind of operation, but are alike in showing a reduced efficiency, indicating a growing fatigue as the day proceeds.

Reduction in the length of the working-day is characterized by an increase in the output of the successive hours and usually by a total increase in that of the day. The optimum duration of work probably varies with the character of the work itself.

The introduction of rest-periods in the working-spell is accompanied, especially when the working-day is long, by a total increase in the day's production. A five-hour working-spell, unbroken by rest-periods, is probably always too long.

Overtime following a day of labor is inadvisable, as is also Sunday work following a week's labor. These tend to impair the working power of the worker.

A hot day tends to impair strength and reduce output. Every effort should be made to keep the body of the worker cool.

Night-work is, in general, less efficient than day-work. Its total output is less, and this, with a long working-night, falls off enormously in the early morning hours. Alternation of periods of night-work with periods of day-work is more profitable than continuous night-work.

Women are capable of performing a much greater variety of industrial operations than has heretofore been recognized. They should not be employed for night-work. They are absent from their work more frequently than men. The problem of women as compared with men in industry is not that of their greater or less efficiency, but rather of the work for which each sex is best fitted.

Food and efficiency are directly connected with one another. Suitable and adequate food can probably be best provided through industrial canteens.

A high labor turnover is incompatible with the highest degree of efficiency. It is expensive, in that it imposes upon the employer the necessity of training new workers, and it is a serious factor in causation of accidents.

Physiological analyses of certain operations have been made by means of the cinematograph and other methods, and it has been found possible to eliminate unnecessary motions and to train workers so as to secure a more regular rhythm, such measures increasing efficiency.

Self-limitation of work on the part of workers has been studied and found to be common. Every legitimate effort should be employed by foremen and managers to eliminate this and to induce workers to work up to their physiological capacity. Driving workers beyond their physiological capacity defeats its own ends.

The stingiest man was scoring the hired man for his extravagance in wanting to carry a lantern in going to call on his best girl.

"The idea!" he scoffed; "when I was courtin' I never carried no lantern; I went in the dark."

The hired man proceeded to fill the lantern.

"Yes," he said sadly, "and look what you got."—Safety Bulletin.

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Metallurgy in the Manufacture of High-Speed Steel*

By ROY C. McKENNA

High-speed steel is one of the most complex, complicated alloys known. A representative high-speed steel contains approximately 24% of alloying metals, namely, tungsten, chromium, vanadium, silicon, manganese, and, in addition, cobalt, molybdenum, uranium, nickel, tin, copper, and arsenic are often found.

The steel, to be within the range of generally accepted analysis, should contain over 16% and under 20% tungsten. If of lower tungsten content, it should carry proportionately more chromium and vanadium. Further discussion in this paper is confined to high-speed steels containing approximately 18% tungsten.

The combined action of tungsten and chromium in steel gives to it the remarkable property of maintaining its cutting-edge at relatively high temperature. This property is commonly called 'red-hardness'. The proportions of tungsten and chromium should bear a definite relationship to each other. Chromium imparts to steel a hardening property similar to that given by carbon, although to a less degree. The hardness imparted to steel by chromium is accompanied by brittleness. The chromium content should be between 3½% and 5%.

Vanadium was first introduced in high-speed steel as a 'scavenger', thereby producing a more homogeneous product, of greater density and physical strength. It soon became evident that vanadium used in larger quantities than necessary as a scavenger, imparted to high-speed steel a much greater cutting efficiency. A range of vanadium content in high-speed steel from ½% to 1½% is permissible. An ideal analysis for high-speed steel containing 18% tungsten calls for chromium, 3.85%; vanadium, 0.85% to 1.10%; and carbon, 0.62% to 0.77%.

The effect of manganese and silicon in proportions usually found in high-speed steel is relatively small.

The detrimental effects of even small quantities of tin, copper, and arsenic are not generally realized by the trade. These elements are seldom determined in customers' chemical laboratories or by public chemists.

In justice to the manufacturer of high-speed steel, attention should be called to the variation in chemical analyses between the best of laboratories. Generally speaking, a steel-works laboratory will obtain more accurate results than a customer's laboratory, or public chemist. This can reasonably be expected, for the steel-works chemist is a specialist, analyzing the same material for the same elements day in and day out.

*Abstract from a paper read at the Convention of American Steel Treaters' Society.

†President, Vanadium-Alloys Steel Co., Latrobe, Pennsylvania.

It is not my intention to make definite recommendations as to the heat treating of high-sped steel by the users. Such steel can be heat treated to give satisfactory results by different methods. However, the trend of American practice is toward the following:

1. Slowly and carefully pre-heat the tool to a temperature of approximately 1500°F., taking care to prevent the formation of excessive scale.

2. Transfer to a furnace, the temperature of which is approximately 2250° to 2400°F., and allow to remain in the furnace until the tool is heated uniformly to the above temperature.

3. Cool rapidly in oil, dry-air blast, or lead bath.

4. Draw back to a temperature to meet the physical requirements of the tool, and allow to cool in air.

Not long ago the desirability of drawing hardened high-speed steel to a temperature of 1100°F. was pointed out, and it is encouraging to learn that comparatively few treaters of high-speed steel have failed to make use of this knowledge. Many steel treaters at first contended that the steel would be soft after drawing to this temperature and it is only recently, after numerous actual tests have demonstrated its value, that the old prejudice has been eliminated.

With an understanding of some of the difficulties inherent in the manufacture of high-speed steel, I will discuss some of the trade practices and customs that have been generally accepted.

Should the customer specify by what process tool-steel is to be made?

No. The customer is more concerned as to the quality of the tool-steel and the service which it gives him. It should be left to the manufacturer to use the process that, in his opinion, gives the most satisfactory product. The customer has a right to know by what process the steel furnished him is made.

Should the customer specify any limits as to chemical composition of high-speed steel?

No. A manufacturer should be willing to co-operate with the trade to the extent of submitting to them his rejection limits of those elements vitally affecting the efficiency of the steel.

Why should high-speed steel be delivered only in the annealed condition?

Because annealing relieves the internal strains inevitable in the manufacture and puts it in much improved physical condition. The manufacturer's inspec-

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tion after annealing also discloses defects not visible in the unannealed state.

Is it advantageous for the buyer to conduct a test on various brands of high-speed steel before deciding upon placing his contract?

The only true test for a brand of high-speed steel is the service that it gives by continued performance month in and month out under actual shop conditions. The average buyer is not justified in conducting a test, but can well continue to purchase his steel from a reputable manufacturer of a brand that is nationally known. The manufacturer is always willing to co-operate with the trade in the conducting of a test and is much interested in the information received from a well-conducted test. A test, to be valuable, should be conducted in a manner as nearly approaching working conditions in the plant in which the test is made, as is practical. In conducting a test a few reputable brands of high-speed steel should be allowed to enter. The test should be conducted along lines laid down by the customer, and all competitors should be treated equally. All tools entered should be of exactly the same size and shape. There is much difference of opinion as to the best practical method of conducting a test, and the decision as to how the test is to be made should be left to the customer, who should co-operate with the manufacturers in devising a test that will give the best basis for conclusions as to how the particular brands of high-speed steel would perform under actual shop conditions.

What is the value of testing finished tools with a file? Can such a test be considered reliable?

The value of the file-test depends upon the quality of the file and the intelligence and experience of the person using it. The file-test is not reliable, but in the hands of an experienced operator, gives some valuable information. The manufacturer of small tools from high-speed steel sometimes carries the file-test to extremes. Almost every steel treater knows of instances where a lathe-tool that could be touched with a file has shown wonderful results as to cutting efficiency.

Should special length bars be specified, or should bars be of ordinary commercial length? Should it be permissible to deliver short bars?

The customer should not specify special-length bars except for special requirements. The manufacturer should reserve the right to ship bars of commercial length and should also be permitted to deliver short bars. These conditions are necessary because of the rejection under final inspection. A physical defect may be found in the middle of a finished bar, which must be eliminated. This results in there being finished, two short bars approximately four or five feet long in place of the usual commercial length, approximately ten feet. For the customer to object to delivery of short bars would result in excessive inexcusable waste. Commercially, a bar of standard size should be considered approximately ten feet long, and the manufacturer should have the right to ship the equivalent number of feet, including a definite percentage of short bars. Twenty-four inches should be the minimum length acceptable to the purchaser, and delivery of pieces of this length should constitute only a small proportion of the quantity furnished. It would be desirable if the trade would co-operate by giving to the manufacturer multiple lengths to which to work whenever practical. Much loss would be avoided by this co-operation.

What deviation in percentages of weight of high-speed steel ordered should the manufacturer be permitted?

A manufacturer should at all times ship as close to weight as possible without cutting bar to length. A maximum limit of 10% over or under should be allowed.

Are the manufacturer's terms of warranty justified?

The terms of warranty almost universally adopted, with slight variations, are as follows: "We will replace or allow credit for any steel which, if properly selected and used, shall prove defective, but we will not allow claims for labor or damage." The universal acceptance of these terms by the buying public would prove their justification. There is no stronger or more equitable form of guarantee in any line of business.

What allowance should be made by the buyer for decarbonization?

The manufacture of high-grade steel has progressed to such a point that buyers, in placing their specifications, barely consider allowance for decarbonization. The allowance made by the buyer should be governed by his experience with the brand of high-speed steel, and should be liberal.

In what manner should a customer who has a complaint as to the quality of high-speed steel co-operate with the manufacturer?

A buyer should invariably ask permission of the manufacturer to return steel claimed defective, or give the manufacturer an opportunity of having one of his experienced service-men inspect and examine material claimed defective at his plant. The customer should co-operate with the manufacturer to the extent of giving the manufacturer all information available regarding the details of shipment, order number under which it was shipped, and time of receipt. This information not only enables the manufacturer to identify the material in question as his own, but gives him an opportunity of investigating the handling of the order in his own plant. In a well-organized plant, this will enable the manufacturer to determine the heat-number from which the steel in question was rolled, its analysis, and other valuable data concerning its working through the mill. It is only by following customers' complaints carefully that the manufacturer is able to correct faults and improve his product.

Is the manufacturer's maintaining of experienced service-men to help solve customer's heat-treating prob-

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lems and secure for them maximum efficiency and production justified?

No expense incident to the manufacturing, selling, and use of high-speed steel has justified itself in actual practice more than the maintaining of an adequate competent corps of service-men. The cost of the best steel is infinitesimal compared with the value of the finished tool in constant daily service. High-speed steel is today marketed upon the basis of quality and service. The maintaining of a competent corps of experienced service-men helps the manufacturer as nothing else could in keeping up and constantly improving the quality of his product. The assurance given to the buyer by a reputable maker that the service department will stand back of his product is well worth the extra expense.

Is the practice of buying high-speed steel by brand names instead of physical, chemical, and metallurgical specifications justifiable?

Yes. The guarantee behind high-speed steel is the standing and reputation of the manufacturer, who should maintain in his employ metallurgists and experienced service-men, who will defend the quality of his product and be ready at any time to heat-treat and demonstrate to the buyer's satisfaction that the product furnished by him will meet any of his reasonable requirements. The customer's specifying the chemical, physical, or metallurgical properties relieves the manufacturer of his responsibility as to quality. Quality is not dependent upon the chemical composition, and poor steel can be made within any limits of chemical content that could be met commercially by a manufacturer. In purchasing steel by brand name the buyer places responsibility for performance clearly with the manufacturer. The specifying of physical, chemical, or metallurgical limits by the buyer would lead to endless controversy and would retard the progress of the industry.

The Foreman's Place in Safety Work*

As long as we must work with the tools as we have them now, the foreman is the big safety factor in every plant. I don't care what your safety committees may do, until your foreman has become a safety man nothing can be accomplished for the reason that he is in contact with the men all the time, while your safety committee meets once a week or less frequently. The safety committee may plan ever so well but it is the foreman who must carry out these plans, and if he is not converted to the idea of safety the plans are never fully carried out. It is surprising when a foreman once becomes 'safe' how many dangers he can find in the work. I find in plants where the foreman has become 'safe' he can show me more dangers and things he thinks should be remedied than anyone can imagine.

I have in mind one plant at which a large number of accidents had occurred, and after having several meetings with the foremen, where I had advised them to insist upon the men doing their work in a safe way, a foreman told me one day that he had lost the best punch-press man he had. I said "Well, you are still running, but how did you lose him?" He said he had told the man to do his work in a different way, and the man had replied that he could not do the work that way and make any money. The foreman told the man if he was to stay there, he had to do the work in a safe way, and the man refused. The foreman then told the man that he was the best punch-man they had, but that sooner or later something would go wrong with the machine over which they had no control, and he would be injured. He said they would have to break in a new man anyway and might just as well start in now as later; if this man wanted to lose fingers he could not lose them there, that he would have to go to some other plant to lose them; and the man quit. If this had happened a year ago the foreman would have been scared to death to think he was going to lose the best punch-press man in the plant, but he was not afraid of it now because he had a platform of safety on which to stand. He was not afraid to break in a new man because he knew he was going to have a safe man. What effect did it have? The other men working there said: "Well if he lets the best man go, what will he do to us?" And the men saw the foreman meant to have the work done in a safe way, and realized that he was working for their interests. Again, a year ago this foreman would have said: "Well, if he wants to lose his fingers, let him; they are not my fingers." But now he said: "If you want to lose fingers you will have to go somewhere else; you can't lose them here."

In a meeting some time ago, I asked the foremen how many of them had explained to the new men the dangers on a press, and to hold up their hands if they had. Not a hand went up, and I will be frank to state that at least 90% of all our accidents on punch-presses happened to new men. So you can see how necessary it is that the new men be fully instructed in their work. The average foreman cannot see much danger in the punch-press. He thinks that if a man will keep his hands from under the die he cannot be injured. Not long ago, I investigated an accident where a man had lost a thumb. They had taken the work from the press on which the accident occurred and put it on another, which they thought was properly guarded. When I watched the new man work I could see that it would only be a matter of time when he would lose not only one, but both thumbs because of the way he was doing the work.

When I called the foreman's attention to this he said "My, my! I showed him twice how to do the work right." So you can see that while he had shown the man the correct method of work when he started, he then let him alone, and the operator had formed the habit of doing the work in an unsafe way.

*Extract from address delivered before the National Safety Council.

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Electric Furnaces in the Steel Industry*

A study of available data reveals the following facts regarding furnaces now installed or contracted for:

Estimated total number of furnaces in the world	815
Estimated total number of furnaces in United States	290
Estimated total number of furnaces in Canada	45
Rated capacity of all furnaces in United States and Canada, tons	1,130
Average rated capacity of furnaces in United States and Canada, tons	3.4
Number of furnaces United States and Canada making ingots	104
Rated capacity furnaces United States and Canada making ingots, tons	735
Average capacity furnaces United States and Canada making ingots, tons	7.3
Number furnaces United States and Canada making castings	231
Rated capacity furnaces United States and Canada making castings, tons	395
Average capacity furnaces United States and Canada making castings, tons	1.7
Number plants United States and Canada making ingots	60
Number plants United States and Canada making castings	126
Rated capacity largest furnaces used for making ingots, tons	40
Rated capacity largest furnaces for making castings, tons	15
Largest plant installation for ingots (5 furnaces), total rated capacity, tons	105
Largest plant installation for castings (2 furnaces), total rated capacity, tons	30

At least 99% are arc-furnaces. The induction type of furnace is not regarded with favor, nor is it being developed to any great extent. Furnaces of three tons capacity or larger are generally arranged for two or three-phase current, and this is to be preferred, from both power-station and consumer's standpoint, on account of the better balancing effect on the phases. A number of small-size single-phase furnaces are also giving satisfactory service.

Electric-steel production may be roughly classed under two heads. That required for ingots, and that which is used directly in the pouring of castings.

In the case of ingot-steel, two general plant arrangements are used; one where steel is melted and refined in the electric furnace, and the other where molten steel, previously prepared in an open-hearth, or other type furnace, is poured into the electric, and there refined. The latter plan gives a greater output per electric unit, and also reduced costs, without any loss in the quality of the product.

In the production of steel castings, practically all plants are melting directly in the electric furnace. This method seems to give satisfactory operating conditions in the foundry business. A few foundries are equipped to charge their electric furnaces with molten metal.

Furnaces are giving satisfactory service on both 25 and 60-cycle circuits. The use of 25-cycle current permits a greater power input to a given furnace than 60-cycle current would, because of lesser magnetic losses and decreased heating and inductive effects in the circuits. A considerably better power-factor is obtained with 25-cycle current than with 60-cycle, other conditions remaining the same. These points, it will be appreciated, apply with increased force as the amount of power-input and consequently the current grows larger.

The largest furnace in use on 60-cycle current is rated at 15 tons capacity. The power-input to a large furnace, operating on 60 cycles, may be limited by the arrangement of electrical conductors between the transformers and the furnace-electrodes.

Furnace capacity is limited by the amount of power per electrode that can be handled, and 3000 kva. seems to be the maximum for a three-electrode furnace. It is for this reason that furnaces of 30-ton capacity are considered as large as it is advisable to construct at the present time. This size furnace, operating entirely on molten charges, using 2000 to 2500-kw. input, should produce from 4000 to 5000 tons of steel per month. This amount of steel from one furnace will meet most plant requirements, and it is possible that the necessity for a larger furnace may not arise. If such should be the case, however, a unit could, no doubt, be constructed using six electrodes with a total capacity of from 50 to 60 tons per heat. For installations requiring cold melting, furnaces of from 1 to 10 tons have been adopted.

The auxiliary equipment used with electric furnaces has been standardized. Most furnaces are motor-operated throughout, except the smaller sizes, which may be operated by hand. Owners of furnaces using automatic control of electrodes have a choice between two or three standard makes of control, all of which have proved satisfactory under service.

As a result of the growth and development of the electric-furnace industry during the past 10 years equipment has become well-standardized. Furnaces and their equipment can be purchased to meet any plant requirements.

The development of additional uses for electric-furnace steel is looked for in the near future. Further increase in the use of electric furnaces depends only upon a demand for the steels and is not limited by lack of furnace equipment. If the demand increases for the high quality of steel that can be produced by the electric furnace in preference to the open-hearth steels, plants can be equipped to meet it.

*Abstract of report by special committee of Association of Iron and Steel Electrical Engineers.

A SYSTEM for filing advertisements of equipment is described by W. N. Allen, Jr., in a recent number of the 'American Machinst', particularly those giving actual figures of production or describing methods of shop operations. The classification is patterned after the Dewey system. Mnemonic symbols are given to the various shop operations, such as *B* for broaching, *GC* for gear-cutting, *SM* for screw-machine operations, etc. Numerical symbols are used for the kind of machine, method of doing the operation, material used, size of work, etc. Names of manufacturers are usually indicated by the initials.

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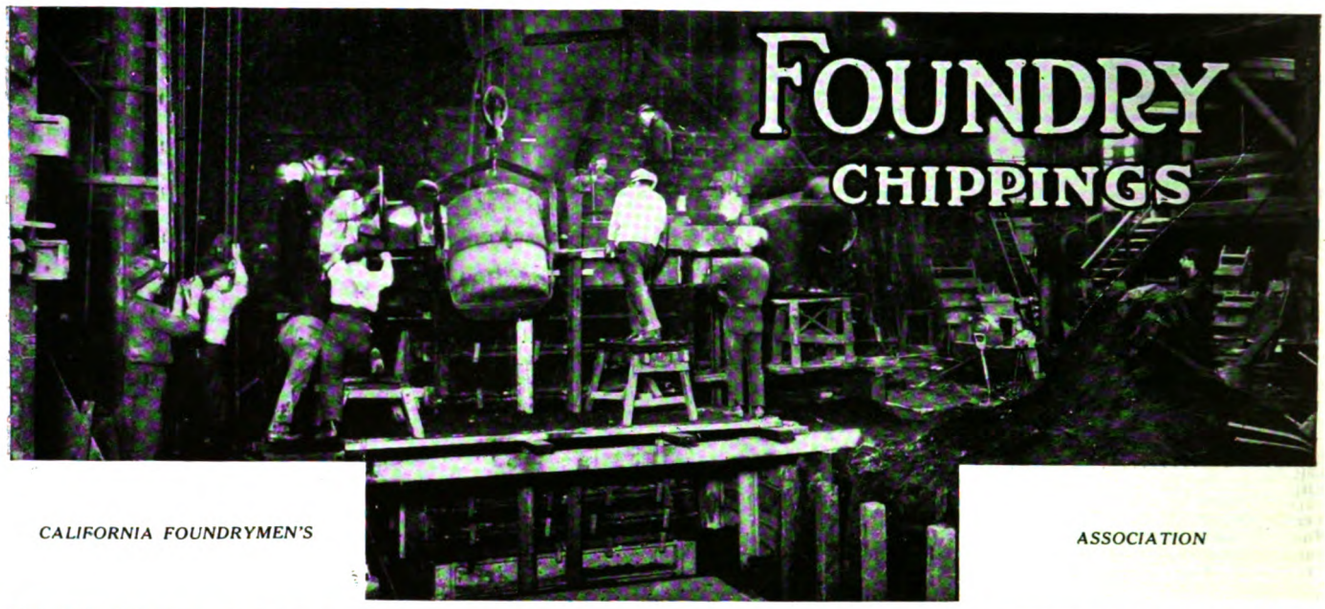
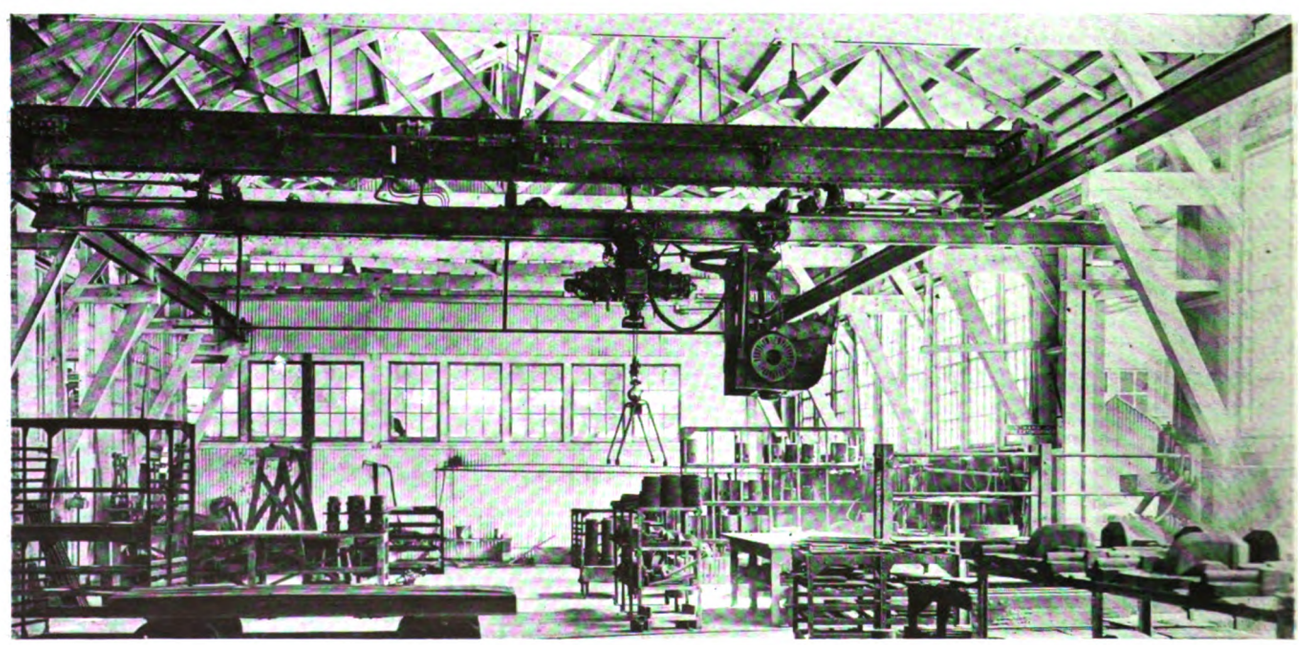


Mono-Rail System of Transportation in the Holt Foundry

Besides the usual large-capacity traveling-cranes, a mono-rail system has been installed for handling material in the Holt foundry. As will be seen from the accompanying sketch, while the heavy cranes cover the entire length of the foundry and half the width, the mono-rail system goes everywhere in the foundry and also runs into the core-room and to the store-room. The mono-rail is an 8-in. I-beam, supported on suitable structural-steel columns. In the foundry, a 2-ton Sprague electric hoist is used, while in the core-room, there is a 2-ton Shepard hoist. The photograph shows the hoist in the core-room ready to pass from the beam on the regular traveling-crane, which covers the entire core-room, out on the mono-rail and thence into the foundry.

An interesting feature of the installation is the fact that the mono-rail climbs a considerable grade in passing from the core-room to the main foundry building. This is because the mono-rail was added some years after the buildings were constructed and the clearances established. There is approximately 14 ft. clearance in the core-room and 18 ft. in the foundry. As it was considered inadvisable to reduce the foundry clearance, an ascending grade from the core-room to the foundry was



SHEPARD HOIST IN CORE-ROOM. TRAVELER IS IN POSITION FOR THE HOIST TO RUN OUT ON THE MONO-RAIL TO THE FOUNDRY

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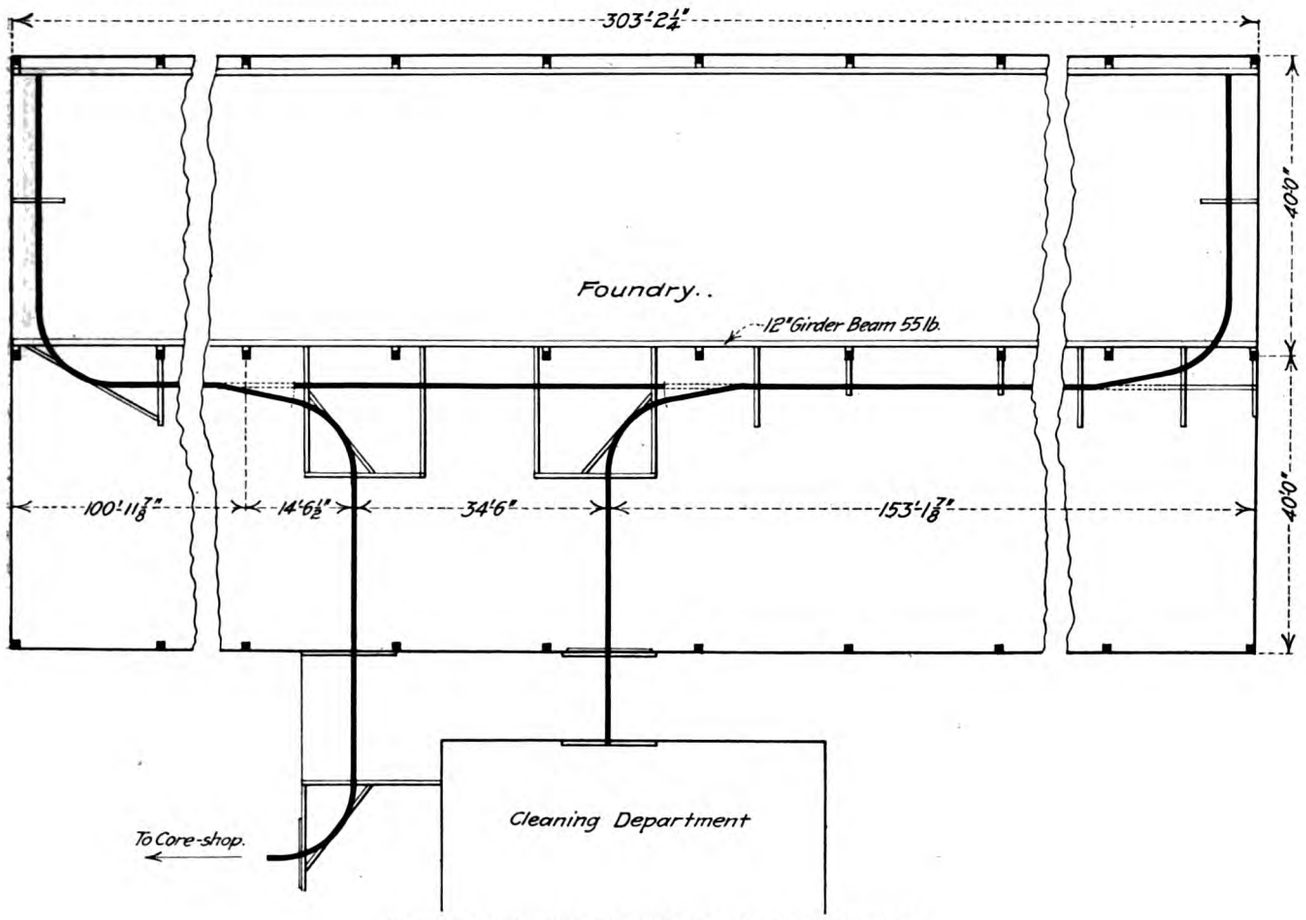

PLAN OF FOUNDRY SHOWING MONO-RAIL SYSTEM

necessary. A rise of 3 ft. 9 in. in 42 ft., or about a 9% grade, is required. While it was recognized that the motors were strong enough to operate on this grade, provided there was sufficient traction, there was some uncertainty as to whether or not the necessary traction could be obtained. However, there has been no difficulty whatever from this cause during operation, and, in fact, the entire system has given satisfaction.

AMOUNT OF GAS REQUIRED FOR CASEHARDENING-FURNACES

In an article appearing recently in the 'American Machinist,' A. J. Smith gives the results of measurements of gas required on an actual casehardening job in a 'Revergen' furnace manufactured by the Davis Furnace Co., of Bedford, England. The furnace is provided with regenerators. Illuminating gas was used. The work consisted of automobile-gears packed in six boxes, the total weight being 713 lb. The material was charged into a cold furnace, and the temperature raised to 1652° F. in 70 minutes. This required 925 cu. ft. of gas, or 1.29 cu. ft. per pound of charge. To maintain this temperature for eight hours required 312 cu. ft. per hour, or 0.44 cu. ft. per pound of charge.

WHY DAYLIGHT LAW FAILED

The secret has leaked out that the real reason why the farmers were opposed to the daylight-saving plan was that they were not able to get the roosters to adopt it. The he-chickens insisted on going to work on the old schedule. In open defiance of Congress, they refused to knock off the extra hour from their morning beauty-sleep. So, under the new plan, instead of the roosters waking the farmers, it became necessary for the farmers to wake the roosters. This, quite naturally, aroused feelings of mutual antagonism. No farmer relishes the task of going out each morning while the moon is still riding high in the heavens, and cuffing a barn-yard full of roosters off the perch. So there was nothing to do but repeal the law.—Thrift Magazine.

A STRUGGLING business man came home one evening with a joyful countenance.

"My poor dear," he said to his wife, "I have just been admitted to the League of Reconstruction Profiteers. Our hard times are now over. At last you can have some decent dresses."

A steely glitter came into the woman's eyes.

"No you don't Joseph," she said, "I'll have just the same kind of dresses all the other women are wearing."—Los Angeles Times.

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European and American Foundry Practice Compared*

By A. O. BACKERT

The prevailing practice of investigators of industrial conditions abroad has been to make invidious comparisons of European production with that of the United States. From the standpoint of tonnage and output per capita, particularly in the metal trades, these comparisons are borne out by statistics. It has been pointed out frequently that restraint of output is the brake upon all industry of the United Kingdom, and that with its removal production could be increased to equal that of this country. Attention also has been directed to the lack of labor-saving equipment and the need of mechanical appliances to increase output.

An investigation of the foundry industry of the United Kingdom disclosed the effect of restraint of output, which, however, was removed during the closing years of the War, and has not again been invoked. Mechanical appliances are not in such widespread use in the casting industry as in this country. Yet many plants are modernly equipped throughout and their practice is equal to the best prevailing in the foundries of the United States. Then what are the underlying causes for the differences in the rates of production? Why is the tonnage per man for shops engaged in similar work so much greater here than in the United Kingdom?

The wide divergence in the standards of the casting buyers of the two countries is one of the underlying reasons. The insistence upon high quality and superfine finish are two requirements that reduce the rate of production abroad. The widespread use of dry-sand molds in the United Kingdom and also in France, to provide the necessary finish demanded by the trade, is a large factor in reducing the output per capita. Quality and finish have been carried to the extreme and at the sacrifice of quantity. In the shops in this country, on the contrary, green-sand practice prevails and quantity production is the goal to be attained, frequently at the expense of finish and quality. That a happy medium between the extremes of quality and quantity would serve the purpose cannot be denied, but years of education in one direction cannot be diverted to another course without an equal amount of training.

Repetition work in this country is one of the factors underlying large production and it lends itself admirably to the application of all kinds of mechanical and labor-saving devices. With us it is not unusual to make 50,000 castings from the same pattern, and in the automobile trade this total frequently is exceeded. Dealing in large numbers of the same unit enables the American foundryman to equip for quantity production and he requisitions for his use the most modern mechanical devices available to increase output and reduce cost. In the United Kingdom and France, repetition work is not nearly so prevalent as in the shops of the United States. Quantity production of commodities is not appreciated in the same degree as over here, nor is the need for it nearly so great. Until this year quantity was not a great factor in the motor-car industry abroad, and even today the largest output of the automobile plants of both of these countries is small compared with the production of many of our motor car manufacturers. Before the War, it has been stated that the total pleasure-car output of France was only 30,000 per annum. When this number is divided among many builders it becomes apparent that repetition work among French manufacturers cannot be developed to a high degree.

In addition, the lack of standardization in many engineering lines reduces repetition work to the minimum. Even the railroads are counted among the violators of standards in equipment and the whim of the designer too frequently is the altar upon which quantity production is sacrificed. It has been stated that manufacturers of sanitary ware in the United Kingdom have patterns in their vaults for several thousand different designs of bathtubs and it is not unusual for an architect to enhance the beauty of his creation by individually designed tubs. The result is a multiplicity of orders for small numbers of castings from different patterns, and this plays havoc with production. Long runs from single patterns lead to production economies, largely effected by the use of molding-machines, whereas small orders for castings from a variety of models retard the installation of mechanical-molding appliances, reduce the output, and are a factor in maintaining the uneconomical practices of the jobbing shop.

To the comparative lack of repetition work in both the United Kingdom and France must be assigned the prevalence of the jobbing shop and the large number of small foundries, ready, even if not equipped, for the production of castings in iron, brass, or steel. However, this semi-job work is not without its compensating features. It has a tendency to develop skilled molders, whereas our specialty shops train men to one operation, not one of whom could make a parting or cut a gate by hand. Notwithstanding these handicaps, the mechanical equipment of many of the foundries of the United Kingdom and France compares favorably with the best practice prevailing in this country. The foundrymen of these countries are alive to the progress that is being made in casting manufacture over here. They are anxious to increase their production and to reduce their costs. To attain these ends they are preparing to install labor-saving equipment on an extensive scale.

Provided with the same machine, on which similar pat-

*Part of annual presidential address delivered at the convention of the American Foundrymen's Association.

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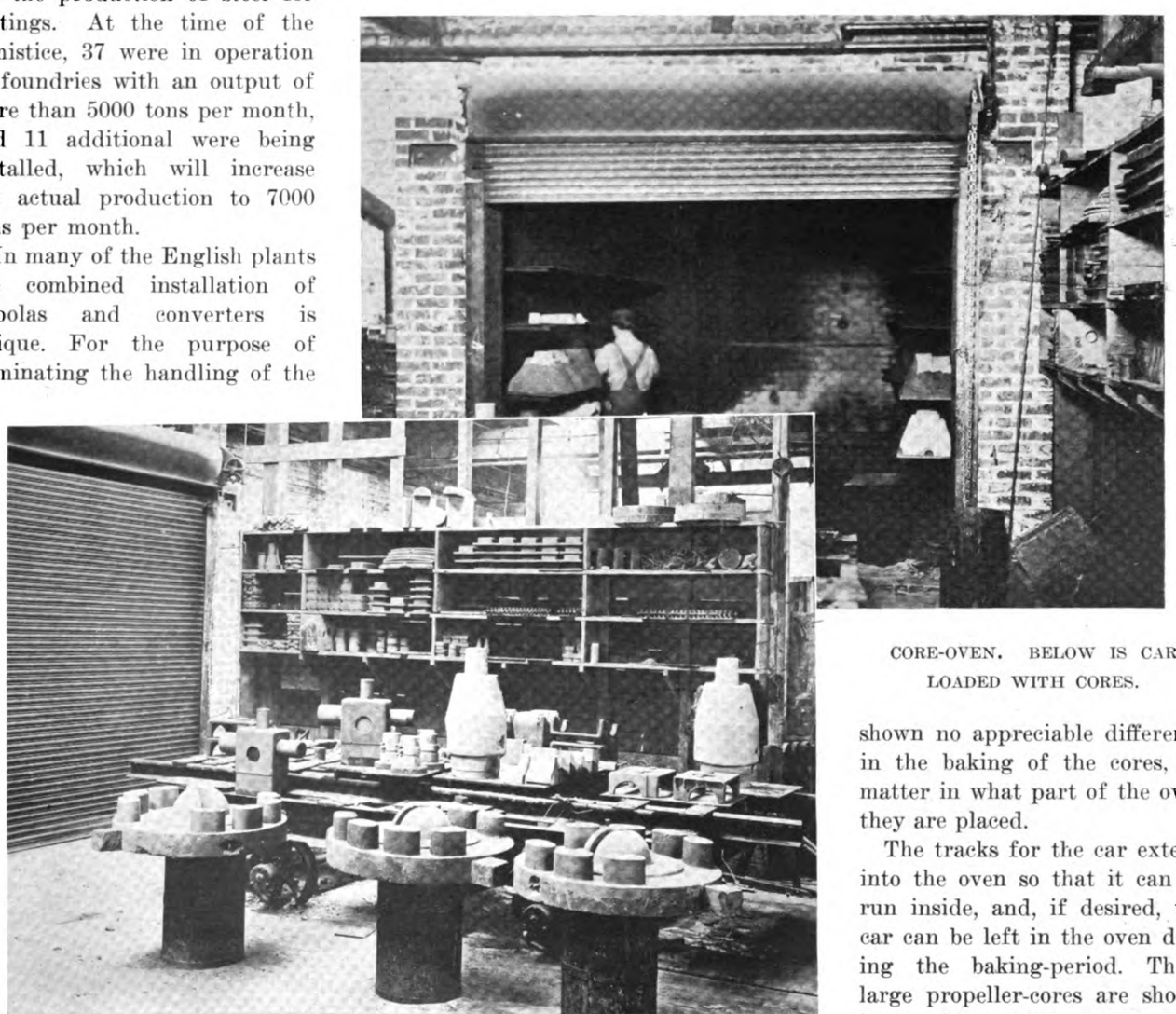
terns are mounted, and operated under practically identical conditions, English foundrymen who have had opportunities to observe foundry practice in this country contend that we get the greater production. That restraint of output, operating for many years, has left its indelible mark upon their workingmen is apparent. Fortunately, in the United States there still prevails the competition of nationalities which is not a factor in England, Scotland, Ireland, Wales, or France. Perhaps when we have centuries of tradition behind us, we too may suffer from the same lack of racial competition.

Steel-casting manufacture in the United Kingdom was greatly accelerated by the War. The output in 1918 was 276,518 tons, of which only 10,564 tons was basic steel, as compared with 265,954 tons of acid castings. This tremendous predominance of acid over basic steel, which is in striking contrast to the practice prevailing in this country, must be attributed, to a very large extent, to the insistence of the army and navy ordnance departments for castings made by the acid in preference to the basic process, and also, in a measure, to the available ores. The War also encouraged the installation of electric furnaces for the production of steel for castings. At the time of the armistice, 37 were in operation in foundries with an output of more than 5000 tons per month, and 11 additional were being installed, which will increase the actual production to 7000 tons per month.

In many of the English plants the combined installation of cupolas and converters is unique. For the purpose of eliminating the handling of the metal in ladles from the cupolas to the converters, the melting-furnaces are on platforms at a considerable height above the floor-level to permit of tapping the iron direct from the cupola-spout into the mouth of the converter. Troughs are provided for directing the metal into the mouth of either converter, one on either side of the cupola.

An Efficient Core-Oven

The accompanying photographs show the core-oven designed and built by the Standard Brass Casting Co. at its plant at Third and Jefferson streets, Oakland. The oven is oil-fired, the source of heat being at the rear of the oven directly behind where the workman is standing. The only exit for the hot gases is in the front part of the oven, at the right-hand side near the floor. This compels these gases to follow a devious course through the oven before escaping. The result is that the oven is heated uniformly throughout. Repeated tests have shown no appreciable difference in the baking of the cores, no matter in what part of the oven they are placed.



CORE-OVEN. BELOW IS CAR LOADED WITH CORES.

The tracks for the car extend into the oven so that it can be run inside, and, if desired, the car can be left in the oven during the baking-period. Three large propeller-cores are shown in the foreground.

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INDUSTRIAL EQUIPMENT

THE HAUCK HAND-KEROSENE TORCH

The Hauck Manufacturing Co. of Brooklyn, New York, has perfected the hand torch shown in the illustration. The half-gallon size will heat a 1½-in. shaft bright red in two minutes and will melt ½-in. round copper in four minutes. This torch is made for hard service. The valve of the

Hand-Torch

burner has an automatic check to prevent hot oil or gases returning to the tank, which remains cool during the entire operation. The burner is of composition heat-resisting metal made in a solid casting. The oil conduits are straight, so that the burner may be readily cleaned by removing two plugs and inserting a straight wire. It produces an intense clean powerful flame with a length up to 13 in. and a temperature of 2000°F. The torch burns one quart of oil per hour. It is particularly suitable for automobile repair work, such as straightening chassis, expanding, pre-heating, and soldering. The torch is handled by Harron, Rickard & McCone, of San Francisco and Los Angeles.

THE RANSOM GRINDING MACHINE

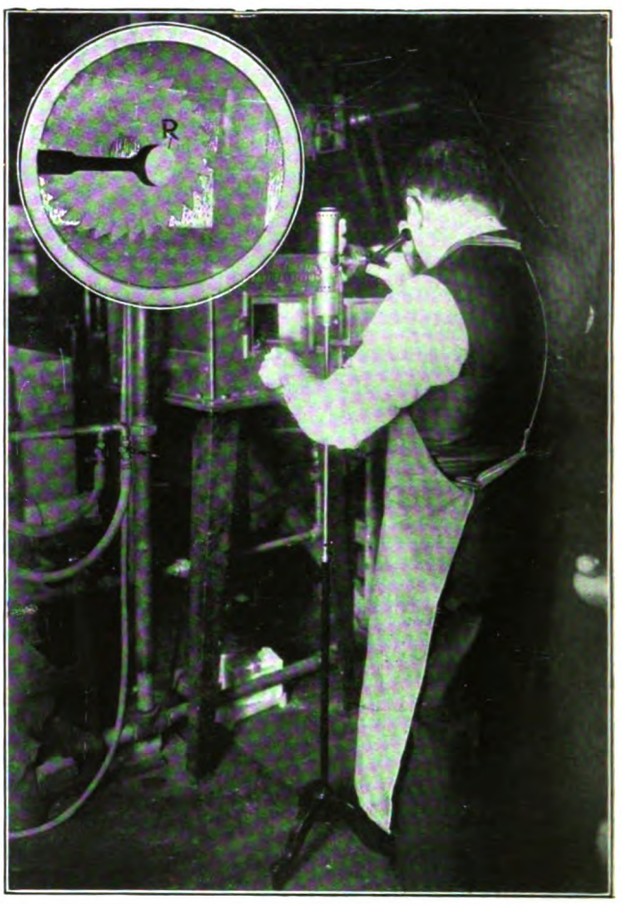
For users of wet-grinding machines, the Ransom Manufacturing Co., of Oshkosh, Wisconsin, has developed the belt-

The Ransom Grinder

driven tool-grinding machine shown in the illustration. The machine is arranged so that the water does not spatter on the floor and on the operator. The tank can be removed easily and cleaned with a shovel. It will hold enough water to last several weeks. There is no water on the wheel except when it is running. The supply is regulated by the valve on the back of the machine. The idler-pulleys are so arranged that they can be used as belt-tighteners. The machine can be arranged for motor drive.

THE SHORE PYROSCOPE

A serious disadvantage of the use of the thermo-electric or other pyrometers depending upon direct contact of some part of the apparatus with the source, is the effect of high temperatures upon any substance. At relatively high temperatures there is rapid oxidation of the part of the appar-



Using the Pyroscope. The insert shows the illuminated disk seen in the telescope, with which the incandescence of the work is compared.

atus in direct contact with the heat, and as the temperature increases there may be softening, absorption of gases, crystallization or alteration of structure, or even fusion. Above 2000°F. temperature measurements depending upon direct contact are particularly difficult, for at these temperatures many of the refractory metals and non-metallic materials are exposed to especially destructive conditions, such as the conversion of dry oxides into acids of great solvent power. Although employed also for the lower temteratures, the Shore Pyroscope, or optical heat indicator, is particularly useful for measuring temperatures above 2000° F. It consists of a telescope and kerosene-burning lamp mounted on a stand. The observer sights the instrument on the hot metal and compares the intensity of the flame with that shown by a reflector. The temperature is read direct after making this comparison. The comparison is based on intensity of light rather than color, so that the personal equation is of no more importance than in making observations with any kind of instrument. In fact, a color-blind person can get accurate results. The pyroscope has

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the disadvantage of being a non-recording instrument, but this is relatively unimportant in many cases. On the other hand, there are no expensive parts to be renewed, or delicate adjustments to be made, with the possibility of error if these adjustments are not correctly made. There is also no 'time lag'. The temperature read is the temperature of the metal at the time the reading was taken. The pyroscope is made by the Shore Instrument & Manufacturing Co., of New York, which is represented by the Braun Corporation, of Los Angeles.

OIL-BURNER

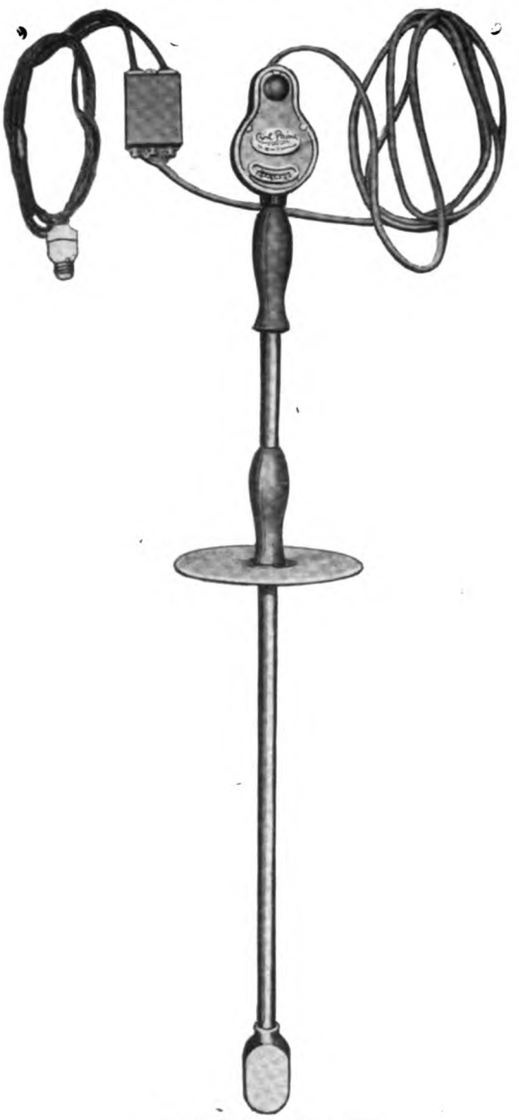
The furnace-burner shown in the illustration has been designed to burn either fuel, crude, or kerosene oil with compressed air at 20 to 100 lb. pressure or steam at a minimum pressure of 25 lb. The oil can be fed by gravity or by pressure. Complete combustion of oil and air, or steam,

Furnace-Burner

takes place in the nozzle of the burner. Combustion does not depend upon firebricks or firebrick lining. There is no spitting of oil or waste of heat. The burner lights instantly. It produces a clean intense flame, which can be regulated as desired. The burner is mounted on a flange with bolt-holes ready for attaching to the fire-box door. Proper space allowance is made for natural suction-draft. Where heavy crude oil is used, the burners are so arranged that they automatically pre-heat the oil. The burner is handled by Harron, Rickard & McCone, of San Francisco and Los Angeles.

MAGNETIC DETERMINATION OF THE CRITICAL POINT OF STEEL

All authorities agree that, provided the steel has been heated above the critical point, the lower the quenching temperature the better. There is also general agreement that for steels with 0.35% or more of carbon, the critical point is definitely indicated by the point where the steel becomes non-magnetic. Bullens in 'Steel and Its Heat Treatment' gives an instance of two steels of the same composition, one of which was quenched at 1450°F. and one at 1400°F., the latter temperature being just above the critical point, as determined by the temperature at which the magnet 'let go'. The remaining heat treatment was identical. To break the first steel took 48 blows of a 10-lb. hammer falling 30 in., while the second steel took 200 blows. To provide an accurate instrument for determining the critical point by magnetic means, the Gibbs Instrument Co., of Detroit, has perfected the 'Crit-Point'. This instrument, which is shown in the accompanying illustration, depends for its operation on making contact with the steel in the furnace through the medium of soft-iron cores. A magnetic indicator is placed in the circuit. When the surface of the steel becomes non-magnetic, the needle on the meter approaches the red line showing the critical point, continuing



The 'Cut-Point' Equipment

to advance toward this line as the heat penetrates the interior and the entire piece reaches the critical point.

WILMARTH & MORMAN GRINDING MACHINERY

The accompanying illustration shows several views of the No. 0 cutter, reamer, and drill-grinder manufactured by the Wilmarth & Morman Co., of Grand Rapids, Michigan. This machine is designed particularly for shops needing a universal grinder, but where there is not sufficient work to justify the purchase of the company's No. 1 machine. In the centre is a general view of the No. 0 machine set for cylindrical grinding. It is suitable for grinding reamers, cutters, taps, counterbores, countersinks, and drills. The table adjustments are such that any angle or compound angle can be obtained easily. The vertical adjustment is made with a worm and worm-wheel pinion and rack making a fine adjustment. The vise has two swivels and a sliding movement, which, together with the micrometer vertical adjustment of the table, permits it to be placed in almost any conceivable position. The upper left-hand corner shows the machine doing internal grinding. Holes up to 5 in. deep and with a 10-in. swing can be ground with this machine. The upper right-hand corner shows a straight flute type of

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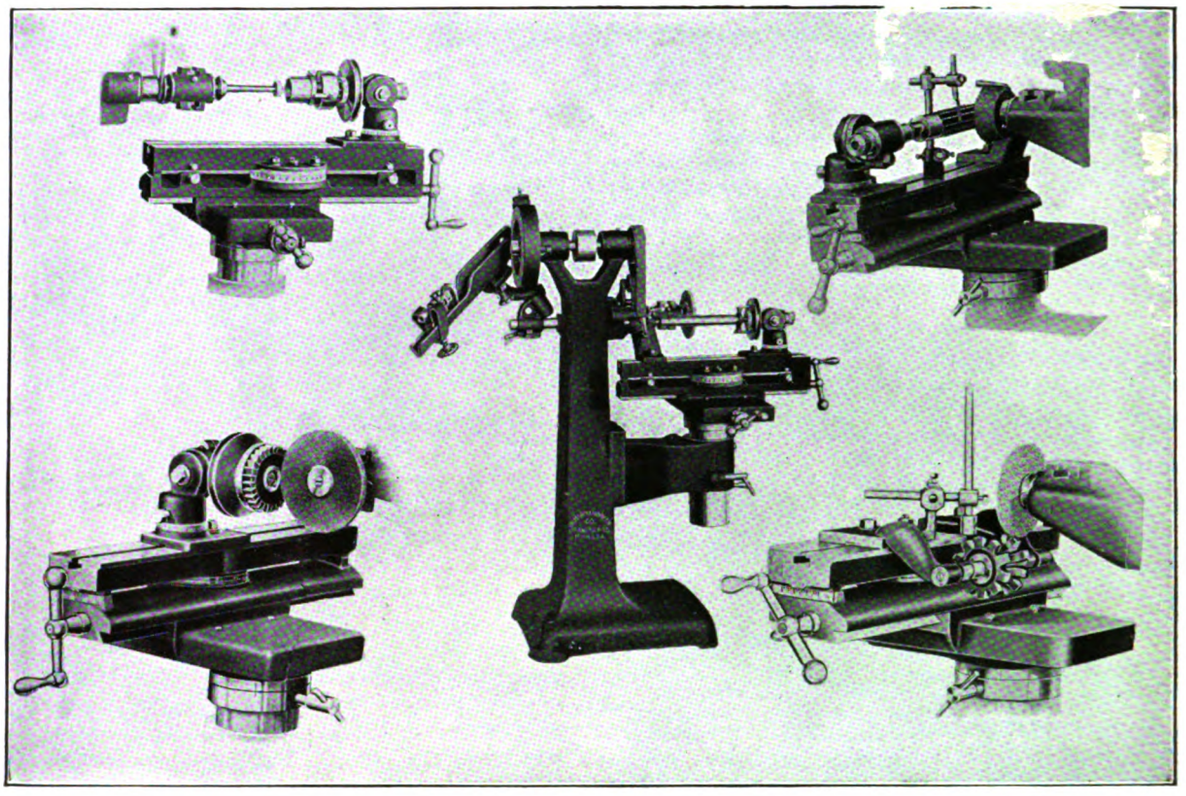
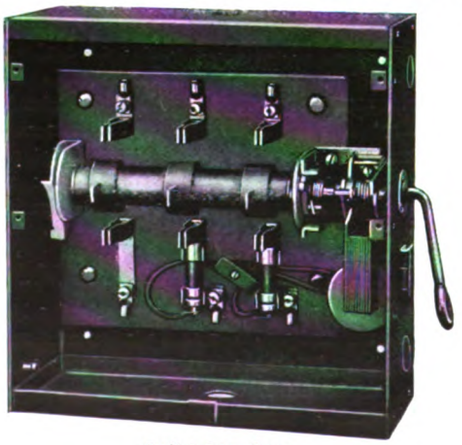


The Wilmarth & Morgan No. 0 Grinding-Machine, Arranged for Various Operations

reamer being ground on a cup-wheel. Taper-reamers and arbors are handled in the same way, except that the table is swiveled to provide for the desired degree of taper. At the front of the table is a fine adjustment that facilitates setting for taper work. In the lower left-hand corner is a face-mill being ground by using the universal headstock. Face and side milling-cutters up to 16 in. diam. can be so ground. The lower right-hand corner illustrates the method of grinding forming cutters by passing them under a saucer wheel. The cutter is carried on a suitable arbor or a mandrel between drop-centres. Gear-cutters can also be ground by this method. Herberts Machinery & Supply Co. is Pacific Coast agent.

A NEW SAFETY MOTOR-STARTING SWITCH

A new type of motor-starting switch, which is low in first cost but provides complete protection to both the operator



Switch-Box Open

and the motor, has just been placed on the market by the Westinghouse Electric & Manufacturing Co. It is known as the type KW-100 switch and is designed for connecting single or polyphase alternating-current motors from 1 to 10 hp., 250 and 550 volts, directly to the line without the use of auto-transformers or resistance.

All of the mechanism with the exception of the operating-

Starting-Switch Locked

handle is enclosed in a steel box. The protective devices are easily accessible on opening a door in the cover; but this door cannot be opened except when the switch is in the 'off' position, nor can the switch be closed when the door is open, and all parts reachable are then dead. Therefore is is impossible to receive injury from contact with live parts either when operating the switch or when making ordinary adjustments. The upper part of the cover is held in place by screws and so can be removed without difficulty by authorized persons, thus exposing the entire mechanism to inspection.

No-voltage protection to the motor is provided by a mag-

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netic release which ... ch automatically on a failure of voltage. Overload protection is provided by means of relays, resembling cartridge fuses in appearance, each of which contains a contact connected in series with the release-magnet. Harmless momentary overloads have no effect on the relays, but as soon as the load on the motor becomes dangerous, the relay-contacts open the magnet-circuit, and the switch opens automatically. The relays then automatically re-set themselves. The switch is so arranged that it cannot be kept closed on an overload or no-voltage, even if the handle is held in the 'on' position.

The entire mechanism is mounted on a slate base and can be removed as a unit without disturbing the box or the conduits. Damaged switches are therefore replaced easily.

The California Pattern Works, now at 181 Beale street, is to move to the upper story of the new building at the corner of Fifth and Folsom streets, erected for **Horace R. Spaulding,** flour-machinery, who will occupy the ground floor. The site vacated by the Pattern Works will be used by the **California Tool Works** which occupies the rest of the building. The latter concern is specializing in the manufacture of the Diamond turn and stop signal.

THE ELECTRO-STYLOGRAPH

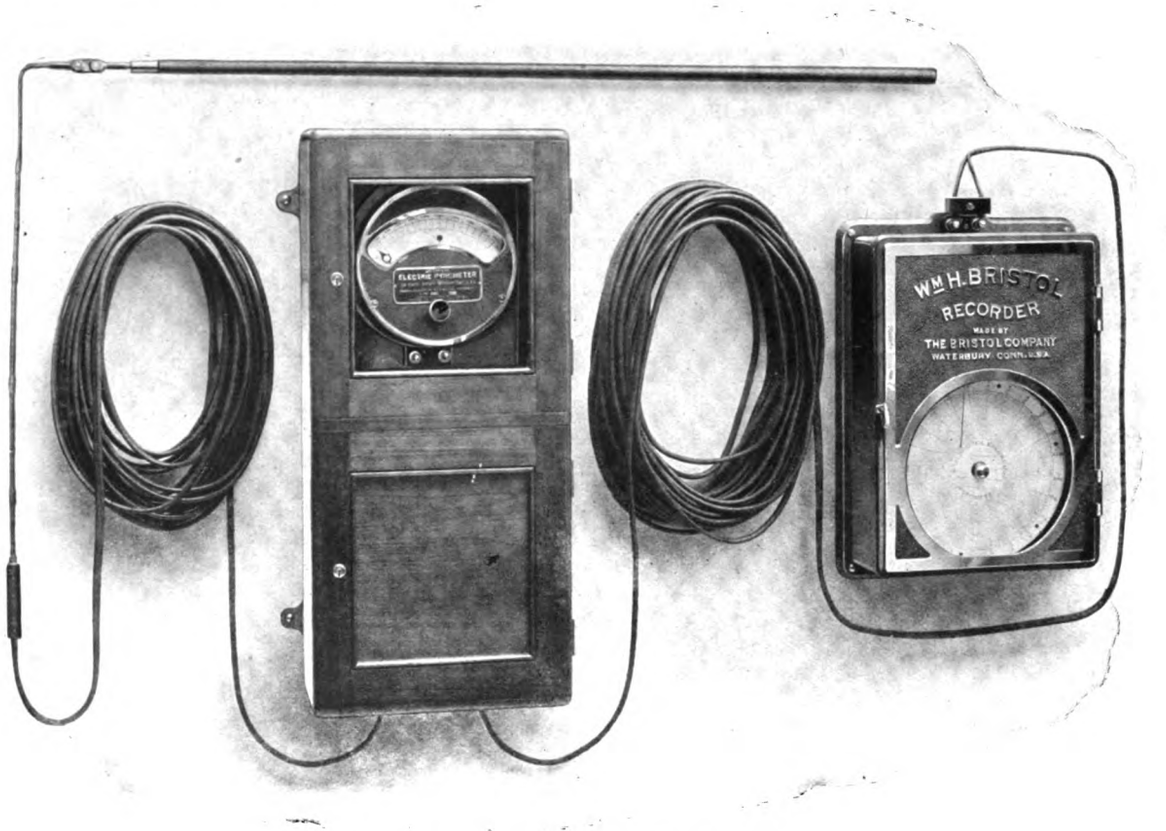
Marking tools or other metal objects by means of stamping or acid etching is a slow and tiresome process, so much so that there is great danger of some pieces going unmarked simply for this reason. The Gibb Instrument Co., of Detroit, has perfected the Electro-Stylograph shown in the accompanying illustration. With this instrument, marking on metal is as simple as writing with a pen, the depth of marking being controlled at will. As it will not disfigure a finished tool, no re-finishing is necessary after marking. The standard machine is designed for alternating current, 60 cycles, and either 110 or 220 volts, but it can also be furnished in other voltages and frequencies.

COMBINATION INDICATING AND RECORDING PYROMETER

Pyrometers are usually needed for two purposes, first, to instruct and guide the furnace operator regarding the temperatures being used, and, second, to provide the superintendent with continuous records of these temperatures, and

Marking Tools with the Electro-Stylograph

with a check on the faithfulness of the operator. To serve these two purposes, the Bristol Co., of Waterbury, Connecticut, has developed the combination indicating and recording unit shown in the accompanying illustration. The indicating instrument can be placed at any convenient place for the benefit of the furnace operator, while the recording instrument may be placed as much as several hundred feet away, both instruments being operated by the same fire-end. In one plant for the heat treatment of steel, 37 of these units have been installed.



Combination Indicating and Recording Pyrometer

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THE NUT-LESS BOLT*

An invention that seems likely to make a considerable improvement in shipbuilding methods with corresponding reduction in costs has recently been patented by John McPhee, superintendent of the riveting department of the Northwest Steel Co., of Portland, and William Hackett, formerly boat foreman at the plant. Both Mr. McPhee and Mr. Hackett are men of wide practical experience in shipbuilding.

The device consists of three parts: a common rivet, or unthreaded bolt, with two shoulders or slots cut or broached on opposite sides near the point; a washer, of the same diameter as the bolt or pin, with a lengthened slot that engages on the shoulders on the pin; and a wedge, made of cast steel, slotted to accommodate the diameter of the pin. The slope of the wedge ceases at a point so as to lock the device so that there is no danger of it slipping under the heaviest vibration.

One of the most important factors in the proper construction of steel ships is the bolting. The rivets are frequently blamed for loose rivets when the real trouble lies in the fact that the two pieces of steel were not properly bolted together. Under the ordinary method this work is done by men working in pairs. One man puts the bolt through the hole in the plates, the other places the necessary washers and, while the first man holds the head of the bolt, the second threads the nut on it until he can turn it no longer. After they have placed several bolts in this fashion, they put an extension pipe on one of the wrenches, and both men put all the effort they can with this additional leverage in order to tighten the bolt.

This is not only hard work, but is also slow and therefore expensive. Further items of cost when this method is followed are the constant inspection of these bolts and nuts to throw out the defective pieces, the cost of re-threading those that are only slightly damaged, and the frequent accidents owing to defective bolts or nuts, and the wrenches to boot.

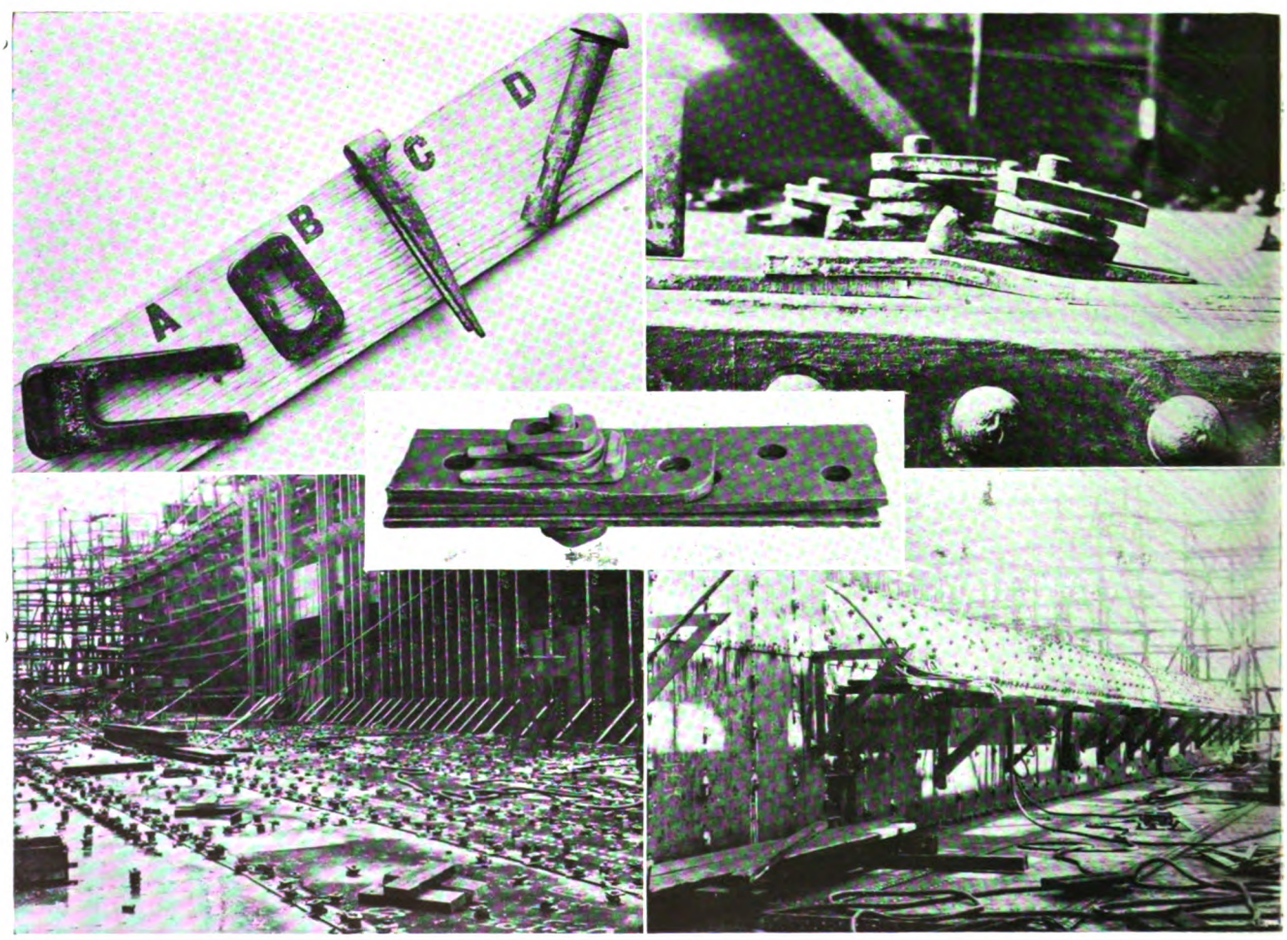
With the wedge-bolt, all these factors are eliminated. The steel wedge is practically indestructible, the slot or shoulder on the bolt stands up under a strain sufficient almost to break the pin in half, and the life of the washer is practically unlimited.

The procedure with these bolts is somewhat similar to that when the threaded bolt is used. Two men work together, one of them inserting the pin, the other engaging the washer over it and against the shoulders, and then placing the wedge. While the first man is sticking the next pin through the plates, workman No. 2 gives the wedge a few raps with a hand-hammer, and the plates are tight. Instead of a bolt in every alternate hole, as in the old method, the wedge-bolt requires less than a third of this number.

The Northwest Steel Co.'s thirty-ninth vessel, the 'Clauseus', was assembled entirely with these wedge-bolts, her tank-testers reported that her tanks are in finer shape than those in any of her predecessors. The riveting of the sheer strake is frequently a source of trouble because of loose rivets. In the 'Clauseus' tests showed only one loose rivet out of a total of 700 for this particular job.

The inventors claim for their device that it will reduce

*From data furnished by A. J. England, editor of 'Heave Together', official organ of the employees of the Northwest Steel Company.



Upper left-hand corner shows the parts of the device. A and C are different views of the wedge, B is the washer, and D is the bolt or pin. At the upper right-hand is part of the bulkhead at the thrust-recess, showing a liner fastened for riveting. The lower left-hand shows the tank-top bolted for riveting. The lower right-hand shows the shaft-alley or tunnel ready for riveting. A curved surface does not hamper the use of the device. The centre shows the bolt in place on two plates.

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materially the cost of ship construction, in that it eliminates the costly threading and re-threading of bolts, puts the nut-maker into the discard, removes the piles of used bolts from the sorting-stands, increases the efficiency of the bolting crews at least 40%, and speeds up the entire operation.

It seems probable that the device can be used to advantage not only in shipbuilding, but also in other work where fabrication of steel is required, such as steel tanks and structural steel in buildings.

NATURAL AND ARTIFICIAL LIGHTING IN THE METAL INDUSTRIES

The Industrial Accident Commission of California has just issued a pamphlet of 60 pages, 'General Safety Lighting Orders', which have been in course of preparation for some time under the direction of a committee of experts chosen to represent the various interests affected. As these orders became effective December 1, and have the same legal standing as the other orders issued by the Commission, owners and managers of buildings and industrial plants will find it advisable to produce a copy of the Orders from the Commission, and to study the same. The pamphlet is, however, more than a mere set of regulations. In fact it constitutes a condensed treatise on industrial lighting. Extracts covering some of the more important subjects discussed in the pamphlet are given below.

Desirable Illumination

	Foot-candles* at floor-level, modern practice	Corresponding minimum, Order 1503†
1. Roadways and yard thoroughfares	0.05 to 0.25	0.02
2. Storage-spaces	0.50 to 1.00	0.25
3. Stairs, stairways, halls, hallways, passageways, aisles, exits, elevator-entrances and elevator-cars	1.00 to 2.00	0.25–0.50
4. Work not requiring discrimination of detail	1.00 to 2.00	0.50
5. Rough manufacturing requiring discrimination of detail	2.00 to 4.00	1.00
6. Rough manufacturing requiring closer discrimination of detail	3.00 to 6.00	2.00
7. Fine manufacturing, accounting, typewriting	4.00 to 8.00	3.00
8. Special cases of fine work	7.00 to 15.00	5.00

*A foot-candle is the lighting effect produced upon an object by a lamp of one candle-power at a distance of one foot.

†This is the Commission's order establishing the minimum illumination to be permitted hereafter.

Table of Recommended Intensities for Detailed Operations and Process (Expressed in foot-candles)

Assembling:	
Rough assembling	2–6
Medium assembling	3–9
Fine assembling	4–12
Extra-fine assembling	7–15
Boiler-rooms, engine-rooms, and power-houses:	
Boiler-rooms	2–4
Coal and ash-handling	2–4
Engine-rooms	3–9
Auxiliary equipment	2–6
Oil-switch and transformer-rooms	3–9
Switchboards	3–9
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Forge-shops and welding:	
Rough forging	2–6
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Foundries:	
Rough molding	2–6
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Tumbling and cleaning	2–6
Grinding, buffing, and polishing:	
Rough work	2–6
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Rough bench and machine work	2–6
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Sheet-metal working:	
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Steel and iron mills, bar, sheet, and wire products:	
Automatic machines	3–9
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Soaking-pits and re-heating-furnaces	2–4
Rolling-mills	3–9
Shears, presses, punches, and riveters	3–9
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Wire-drawing (coarse)	3–9
Wire-drawing (fine)	4–12
Pickling and cleaning	2–6

Adequate daylight facilities through large window-areas, together with light, cheerful surroundings, are highly desirable and necessary features in every work-place, and they should be supplied through the necessary channels not only from the humane standpoint, but also from the point of view of maximum plant-efficiency. Three important considerations of any lighting method are sufficiency, continuity, and diffusion. With respect to the daylight illumination of interiors, sufficiency demands adequate window-area; continuity requires (1) large enough window-area for use on reasonably dark days, (2) means for reducing the illumination when excessive because of direct sunshine, and (3) supplementary lighting equipment for use on particularly dark days and especially toward the close of winter days; diffusion demands interior decorations that are light in color as practicable for ceilings and upper parts of walls, and of a dull or mat finish in order that the light which enters the windows or that which is produced by lamps, may not be absorbed and lost on the first object that it strikes, but that it may be returned by reflection and thus be used over and over again. Diffusion also requires that the various sources of light, whether windows, skylights, or lamps, be well distributed about the space to be lighted. Light-colored surroundings as here suggested give marked economy, but their main object is perhaps not so much economy as to obtain a result that will be satisfactory to the human eye.

The following requirements may now be listed for natural lighting:

1. The light should be adequate for each employee.

2. The windows should be so spaced and situated that daylight conditions are fairly uniform over the working-area.

3. The intensities of daylight should be such that artificial light will be required only during those portions of the day when it would naturally be considered necessary.

4. The windows should provide a quality of daylight that will avoid a glare from the sun's rays and light from the sky shining directly into the eye, or where this is not feasible at all times of the day, window-shades or other means should be available to make this end possible.

5. Ceilings and upper parts of walls should have a light color to increase the effectiveness of the lighting facilities from window-areas. The lower parts of walls should be somewhat darker in tone to render the lighting restful to the eye. Factory green or other medium colors may be used to good effect.

In all the work of providing natural light, it should be kept in mind that direct sunshine in itself, from the illumination standpoint, but irrespective of sanitary conditions, is not wanted. The idea that sunshine is the important item is a common but an erroneous impression. For example, in saw-tooth construction, the windows do not face the south to get all the sunshine possible, but they face the north to exclude the sunshine. In ordinary construction, on the other hand, windows face all directions because not enough light can be distributed to interiors from north windows alone. Windows on other than north fronts admit sunshine,

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and this makes sun-shades and awnings necessary to exclude the excessive brightness.

The following requirements for factory and mill lighting are made all the more important by the peculiar limitations and the wide variety of conditions to be found in factory and mill buildings and in factory and mill work:

1. Sufficient illumination should usually be provided for each workman irrespective of his position on the floor-space.

2. The lamps should be installed and selected so as to avoid eye-strain to the workmen.

3. The lamps should be operated from sources of supply that will ensure reliable illumination, particularly on account of the demoralizing effect caused by intermittent service, just when the light may be most needed.

4. Adequate illumination should be provided from overhead lamps so that sharp shadows may be prevented as much as possible, and in such measure that individual lamps close to the work may be unnecessary except in special cases.

5. The type and size of lamp should be adapted to the particular ceiling-height and class of work in question.

6. In addition to the illumination provided by overhead lamps, individual lamps should be placed close to the work if in the opinion of a lighting expert they are necessary. In such cases, the lamps should be provided with suitable opaque reflectors.

These requirements may now be met by means of the types of gas and electric lamps, some type of which can be found to fill practically any factory need, especially adapted to the physical conditions, such as clearance between cranes and ceiling and other similar items.

In factories motor-loads are likely to be large in comparison to the energy consumption of electric lamps in service. In some cases, the proportion of motor load to lighting load is as much as 10 to 1. The varying demands on the circuits by motors may affect the lamps. Hence it is important to maintain separate supply-circuits for the lamps in order to avoid varying voltage, which is likely to occur if the motors are connected to the same circuits with the lamps. In addition to the superior illumination obtained from lamps supplied from constant-voltage mains, some types operate with longer life or much better mechanically when supplied with constant voltage than otherwise. These features will generally more than offset the somewhat greater cost of maintaining separate circuits for each class of service. For similar reasons, it is advisable to place gas-lamps on supply-lines separate from those delivering gas for power purposes.

The control of lamps in factory and mill lighting is important in all cases, but especially so where a relatively large number of lamps is used for a given floor-area. For example, where an overhead system of tungsten lamps of small size is used, a relatively large number will be necessary for a given floor-area, and the number of control-circuits may seem excessive when arranged for sufficient flexibility of operation. The cost of such circuits, however, will be more than justified by the saving in energy and maintenance from turning out lamps not needed in certain parts of the factory, provided the number of hours per day during which the lamps are used on the average is relatively large, and the differences in daylight intensities over the floor-area is also relatively large. The lamps most distant from the windows will usually be required at times when the natural light near the windows is adequate, thus making it an advantage to arrange the groups of lamps in circuits parallel to the windows. The advantages of this method are further apparent when it is considered that if the lamps are controlled in rows perpendicular to the windows, all lamps in a row will necessarily be lighted at one time, while a part only may be required.

Provision should be made for systematic maintenance of natural and artificial lighting. Factory and mill windows become covered in time with dirt, and decrease the natural light in consequence. These losses may easily be great enough to affect the workmen seriously, and to necessitate the use of artificial light at times when otherwise it would not be required. Dark surroundings also increase the likelihood of accidents. Regular window-cleaning should therefore be a part of the routine of every factory and mill building or group of buildings. Carbon-filament, mercury-vapor, gas-mantle, and tungsten lamps burn out or break, globes and reflectors become soiled, and the various items of deterioration take place so gradually that in many cases they are given no special concern in the practical economy of the shop. Moreover, lighting systems are often allowed to deteriorate to an extreme point and nothing is done unless complaints come from employees after the lighting facilities have become so poor that the work has to be discontinued temporarily. The losses of time from such circumstances, when added up throughout a year, are likely to exceed the expense of systematic attention to such maintenance items in advance. Furthermore, with modern methods, where the lamps are usually mounted overhead rather than close to each machine, the importance of relieving the workmen from care of the lamps, and placing it in the hands of a maintenance department is even greater than has been the case in the past, particularly in large plants.

There is a serious loss of light when globes and reflectors are allowed to go for long periods without cleaning.

In a typical instance of a tungsten globe with a glass reflector, the loss of light at the end of a four-month interval amounted to about 50%. The cost of electrical energy in this shop was such that the loss of light during the fourth month amounted to about 12c., while the cost of taking down, washing, and replacing this reflector was 3c. The economy of frequent cleaning of such reflectors is at once apparent, even if the improved condition of the light itself be ignored.

In one large factory a regular method of inspection and renewals is employed. All the lamps are inspected once per day, except Saturday and Sunday. A regular route is followed by the inspector, and burned-out lamps, broken switches, loose fuses, and similar items are noted. Careful observation is also made of reflectors that appear to need washing and of any other points that might affect the efficiency of the system, after which a report is prepared about noon and sent promptly to the maintenance department so as to permit all renewals and repairs to be made before night. To facilitate this renewal work, all columns are marked. The inspector is thus able to indicate clearly the position of each burned-out lamp and the renewal-man is able to find it without delay. It is helpful to have the inspector note now and then the unnecessary lamps found burning when artificial light is not required. If lamps are found burning at such times, a note sent to the head of the department calling attention to the matter is usually sufficient to remedy the difficulty.

As a check on a regular cleaning-schedule the inspector should note all reflectors in need of cleaning. The frequency of each cleaning will depend on the rate of deterioration caused by the settlement of dirt on the surface of the glass or metal and also on the surface of lamps, and it should be remembered that the amount of dirt on a reflector is nearly always deceptive. Reflectors that have suffered a large deterioration in efficiency from dirt often appear fairly clean, and for this reason it is best to increase the frequency of cleaning somewhat over that which seems sufficient from observation, particularly in view of the fact that tests indicate large reductions of light from apparently small accumulations of dust and dirt.

The Coast Tire & Rubber Co. will construct a plant for making automobile-tires at Oakland.

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Book Reviews

Applied Science for Metal Workers. By William H. Dooley. Pp. 467, ill., index. The Ronald Press Co., New York. Price, $2.

This book is designed particularly for use as a textbook in the metal-working classes of vocational high courses. The principal facts of elementary physics and chemistry are discussed and their application to the metal-working trades considered. The treatment is necessarily condensed, but the explanations are clear, and the book could be read and even studied with profit by many that are not high-school students.

Mutual Interests of Labor and Capital. By George W. Cartwright. Pp. 142. The Mutual Interests Association of America, Los Angeles.

This book contains seven short addresses on present-day questions, with the following titles: Socialism, Labor and Capital, Bacon and Beans, Freak Laws, Agitators and Demagogues, Regulation of Business by Law, German Efficiency and American Liberty. The style is clear and forceful, and suffers little or nothing by the transfer from the spoken to the written word. The author pleads for a square deal to both labor and capital, and for a recognition by both of their mutual interests. We commend the study of this little volume to the 'man in the street', the man at the desk, and the man in the shop.

Strength of Materials. By John Paul Kottcamp. Pp. 189, ill., index. John Wiley & Sons, Inc., New York. Price, $1.50.

This is an elementary textbook requiring a knowledge of algebra and preferably of theoretical mechanics on the part of the student. The first chapter reviews the elementary principles of the latter subject, after which simple stresses are discussed. The more common materials of construction, their strength and the methods used in their manufacture are then considered. Stresses in, and the design of, beams, shafting, columns, and riveted joints are then discussed in their order. The last two chapters deal with combined stresses and resilience, and with reinforced concrete. A number of practical problems are given at the end of each chapter.

Inductive Interference Between Electric Power and Communication Circuits. Pp. 1140, ill., index. Published by the Railroad Commission of the State of California, San Francisco. Price, $10.

This publication is of special interest to electrical engineers, particularly those engaged in railway, power, telephone, or telegraph work, to manufacturers of electrical apparatus, and to State and Federal regulatory bodies, and it should be a reference book in all scientific libraries. The volume consists of the 30 most important technical reports of the Joint Committee on Inductive Interference, selected from the 71 that were issued from time to time during the investigation. It also includes the preliminary and final reports of the Committee to the Commission, and the General Order No. 52 of the Commission prescribing rules and principles governing the construction and operation of power and communication lines for the prevention and mitigation of inductive interference. The book represents the results of extensive field and laboratory tests and investigations for over five years by a staff of electrical engineers from all parts of the United States, at an expense in excess of $100,000. The work of the Committee covered the field and laboratory tests of actual inductive interference, together with theoretical studies, between existing power and communication lines, transformer connection, loading, etc. Analyses were made of causes of inductive interference, magnitude, qualitative and quantitative effects under varying conditions, methods of prevention and mitigation of interference, and special characteristics of the phenomena. The final order of the California Railroad Commission represents the most enlightened regulation upon the subject. This volume covers the subject of inductive interference between electric power and communication circuits in a comprehensive manner and is the most complete and authentic work of its kind in existence. On account of the limited edition available and since it is not likely, because of its highly technical character, that the work will be reprinted, we would advise engineers and others that wish to secure this book to place their orders with the Commission as early as possible.

Trade Notes

Champlin & Worley have opened an auto-repair shop at Lemoore.

Don Lee will construct a $200,000 automobile salesroom and garage at Sacramento.

The Ulmer Machinery Co., Porterville, has moved into a new building 110 by 180 feet.

I. N. Bridges is constructing a galvanized iron building at Cloverdale for a machine-shop.

The Byron Jackson Iron Works has established a branch distribution-warehouse at Willows.

J. S. Hunter and **Nat Strong,** formerly of Coalinga, have established an automobile-repair shop at Ventura.

W. S. Lewis is remodeling a building at Paso Robles for the purpose of establishing a tractor-repair shop.

The Rothert Process Co., of Seattle, has installed a two-ton electric furnace for making alloys of various kinds.

Liggett & Austin are erecting a sawmill at Peoria, Oregon, three times the capacity of the one destroyed by fire last July.

Plans have been completed for a one-story class C shop-building on Valencia near Twenty-Fourth street for **E. L. Prince.**

The Hammond Lumber Co., of Eureka, will build a steel-frame and concrete boiler and fuel-house in connection with its plant.

The Angeles Aircraft Corporation, of Seattle, will construct a plant for manufacturing aeroplanes at Centralia, Washington.

The Enterprise Brass Foundry, of Seattle, has recently purchased considerable new equipment, including a ten-ton traveling crane.

The Honolulu Iron Works Co. has decided to go ahead with its repair works, at Manila. This shop will be the fourth unit in its system.

The Francis Motor Co., of Portland, has filed plans for the construction of a new brick and concrete plant 90 by 95 ft. to cost approximately $40,000.

W. H. and H. C. Fenchel and J. T. Peek have formed the **General Machine Works,** of Pittsburg, and will construct a building for a machine-shop.

The Salsina Canning Co., San Jose, will spend at least $100,000 during the winter in making alterations and buying machinery for its cannery.

The Pacific Iron & Steel Co., Los Angeles, has been incorporated with a capital of $100,000 by D. M. Ward, A. J. Anderson, and C. E. Bradburn.

The Paulson Machine Works, Portland, has been incorporated with a capital of $7500 by Walter O. Paulson, Theodora Pitz, and Henry Bonsert.

The Oregon Machinery Co., Eugene, Oregon, is building a shop in that city. It will do general mill work, specializing on repairing sawmill machinery.

The Earl Fruit Co. has purchased the **Klamath Falls Co.** for $700,000. By this purchase the Earl company secures a

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sawmill, box-factory, and extensive lumber and timber holdings in California and Oregon, and in the future will manufacture its own fruit-boxes.

The Payne Bolt Works is erecting a three-story brick addition to its plant at the south-east corner of Howard and Main streets at a cost of $47,500.

The California Southern Railroad Co. will extend its line from its present terminus at Blythe, Riverside county, to Ripley, nine miles south of Blythe.

The Great Western Milling Co., of Los Angeles, will construct a $1,000,000 flour and feed mill, including a public grain-elevator on the Oakland estuary.

The new plant of the **Moreland Motor Truck Co.** at Burbank, near Los Angeles, will be completed about January 1. The total estimated cost is $2,000,000.

The Lucey Manufacturing Co. will open a branch at Singapore for handling its line of oil-well supplies and other machinery. R. L. Wilson will have charge.

The Livermore Hardware Co. has been purchased by Carl G. Clarke and Leslie A. McVicar and will be conducted under the name of the **Valley Hardware Company.**

The Mohr Steel Co., San Francisco, has been incorporated with a capital of $25,000 by B. H. Barber, J. Bass, J. M. Finlayson, T. Haase, W. E. Jewell, and R. Mohr.

The store of the **Kutner-Goldstein Co.** at Fresno was destroyed by fire on November 11. The loss is estimated at $400,000. The store will be rebuilt immediately.

The Loggers & Contractors' Machinery Co., Portland, Oregon, will erect a new plant on a 17-acre tract of land at Vancouver avenue and Columbia boulevard, Portland.

The name of the **McDougal-Overmire Co.** of Portland has been changed to the **Overmire Steel Construction Co.**, C. C. Overmire becoming the president and sole owner of the company.

F. D. Sprague and **H. A. Sprague** are installing a sawmill four miles from Toledo, Washington, with a capacity of about 20,000 ft. and plan to double the capacity at a later date.

The Willamette Iron & Steel Works, of Portland, has completed installing oil-burning equipment for the 'Grace Dollar' formerly the 'War King', and now owned by the Robert Dollar Company.

Plans are being prepared for the new factory building of the **Hawaiian Fertilizer Co.**, in Iwilei. It will cost approximately $100,000 and will nearly double the milling and storage capacity of the works.

A hospital costing $400,000 will be erected at Sacramento. It will be under the joint management of representatives from the Sacramento County Medical Society and of a Roman Catholic sisterhood.

The Blaw-Knox Co. has been awarded the contract for furnishing steel round-column forms to be used in the construction of the cotton-mill and warehouse of the Goodyear Tire & Rubber Co., at Los Angeles.

Construction has been started by the **Superior Manufacturing Co.**, of Lodi, on a $75,000 factory-building. The company manufactures pumps and pump-accessories, and controls some important patents in these lines.

Arthur F. L. Bell, formerly chief engineer for the **Associated Oil Co.**, has been appointed manager of the manufacturing department, with headquarters at San Francisco. **L. D. Jurs** succeeds Mr. Bell as chief engineer.

The Armistead Ashley Engineering Corporation, of Reno, has obtained permission to sell stock from the California State Commissioner of Corporations. The company expects to build a machine-shop at some California point.

G. F. Coleman announces the incorporation of the **Ferro Alloy Co.** A factory will be erected at Martinez by next July. The site has been secured and bids for work calling for an expenditure of $250,000 are under consideration.

The factory of the **Marchant Calculating Machine Co.** was badly gutted by fire on November 29. It will be rebuilt at once. The company's die-vault was uninjured and the damage to a large part of the machinery was relatively small.

Smith-Booth-Usher Co. has moved its San Francisco office from the Rialto building to 40 Fremont street. A showroom for the machinery and equipment handled by the company will be maintained in connection with the new office.

Bids will be received until December 22 by the Board of Supervisors of Alameda county for the construction of the first unit of the new county hospital. The estimated cost of this unit is $500,000, and of the entire hospital, $2,500,000.

The Pacific Elevator & Equipment Co. has moved its office and shop to 1129 Howard street, where it is manufacturing a complete line of freight-elevators. The company is also agent for the **Montgomery Traction Elevator**, of Moline, Illinois.

Construction of two additions, which when finished will give the **Boyle Manufacturing Co.**, of Los Angeles, about 137,000 sq. ft. of additional floor-space, will be completed about January 1. The new buildings will be used for the manufacture of tubs and buckets.

Contract for construction of five 9500-ton steel ships for the Nafra Co. of New York has been awarded to the **G. M. Standifer Shipbuilding Co.**, of Vancouver, Washington. The general design of the ships will be the same as those built for the Emergency Fleet Corporation.

The California State Railroad Commission has issued a certificate of convenience and necessity to the **Southern California Edison Co.** for the construction of the company's proposed hydro-electric plant on Kern river together with transmission lines. The total estimated cost is $10,000,000.

The Pacific Gas & Electric Co. has applied to the California State Railroad Commission for permission to lease and operate all the properties of the **Sierra & San Francisco Power Co.** for a period of 15 years. Preliminary arrangements have already been made between the two companies.

The Pelican Bay Lumber Co., of Klamath Falls, is rebuilding a large sawmill to replace the one recently destroyed by fire. The main building will be 70 by 200 ft. The plant will have two bandsaws, one horizontal resaw, two edgers, one trimmer, one slasher, and a complete lath-mill.

The Axelson Machine Co., of Los Angeles, has issued catalogue No. 105 describing its line of oil-well pumps, suckerrods, and fittings, including also the company's grinders and heavy-duty lathes, which are of special interest to the metal trades, as the Axelson company is the only concern in California that manufactures machine tools from 'the ground up'.

The South San Joaquin Irrigation District has applied to the California State Water Commission for permission to divert water from various tributaries of the Stanislaus river. The work will require the construction of two large rock-fill dams and several miles of main canal at a total estimated cost of $2,000,000.

The Northwest Steel Co., of Portland, has delivered the last of the 35 steel ships built in its yard for the Emergency Fleet Corporation. The first 15 of these ships were started for private parties and requisitioned by the Emergency Fleet Corporation, while the remaining 20 were under direct contract with the Corporation.

The Harris Manufacturing Co., of Stockton, has extended its facilities by the purchase of the plant of the Gilbert-Hunt Manufacturing Co., at Walla Walla. The Walla Walla factory will be used first as an assembling plant for the company's harvesters, and later, as machinery is installed, for their manufacture complete. The Stockton plant of the company has also recently been enlarged.

The General Electric Co. has purchased all the property of the **American Marconi Co.** Plans for development include the establishment of wireless stations covering practically the entire world. The San Francisco station of the Marconi

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company, which has been closed since the beginning of the War, will be superseded by a larger plant.

The last spike in the **San Diego & Arizona Railroad** was driven on November 15. The road has been under construction for several years, completion having been delayed by the War. It runs in an easterly direction from San Diego to El Centro, and from there trains will go by way of Calexico to Araz Junction on the main line of the Southern Pacific railroad a few miles west of Yuma, thus providing a direct line from San Diego to Yuma and points east. Regular freight and passenger service will be started early in December.

William A. Folger, second vice-president of Berger & Carter Co., severed his connections with that company in November, after 18 years service, and will go into business for himself as representative of several Eastern machinery houses. For the present he is making his headquarters in the Cunard building. He expects to go East shortly after the first of the year and on his return will establish permanent headquarters.

Tate-Jones & Co., Inc., furnace engineers, of Pittsburgh, prepared a booklet for distribution at the recent convention of the American Steel Treaters' Society. Besides a description of some of the furnaces and furnace equipment manufactured by the company, the booklet contains Chapter V on 'Normalizing and Annealing' of a handbook on heat-treating soon to be issued by the firm. If the other seven chapters of the book are as complete as Chapter V, the handbook will be in demand by everyone engaged in heat treating.

The employees of the **Holt Manufacturing Co.** and their families and friends were the guests of the company at a 'safety entertainment' given November 21 at a Stockton theatre under the direction of the company's central safety committee. The program included a talk by Will J. French, of the State Industrial Accident Commission, several motion-picture films illustrating the importance of safety work and precautions, and of fire protection, as well as a number of high-class vaudeville numbers by employees of the company.

The Llewellyn Iron Works has issued a 'Marine Catalogue', which not only contains much valuable information, but is also particularly attractive from an artistic standpoint. Photographs and descriptions are given of the principal features and of typical operations at both its Los Angeles and its Torrance plant, followed by descriptions of the marine engines, boilers, winches, capstans, fuel-tanks, etc., manufactured by the company. The catalogue also contains a list of the principal equipment manufactured by the company in all lines.

The Federal Wool Manufacturing Co. has filed articles of incorporation. The company is capitalized at $2,800,000 and has secured a site at Oakland, where it will erect a plant for scouring, carding, combing, and spinning wool, and turning the raw product into finished yarn for the textile manufacturer. The officers are: Edwin P. Hulme, San Francisco, president; J. L. Halman, Boston, vice-president; and E. J. Gates, Los Angeles, Arthur H. Breed, Oakland, A. J. Treat, Sausalito, and A. H. McLeran and G. C. Stephens, San Francisco, directors.

Articles of incorporation were filed by the **Kroyer Manufacturing Co.** on November 17. The company is capitalized at $5,000,000, $1,250,000 being 7% cumulative preferred stock, and the remainder common stock. The directors are J. M. Kroyer, C. H. Kroyer, Paul S. Smith, Percy S. Webster, F. B. Nims, H. P. Cowley, and V. C. Cassilis. Experimental work on the Wizard 4-Pull tractor, which the company is to manufacture, is reported to be practically completed. The company has acquired a 30-acre tract near the eastern city limits of Stockton, on which it expects to start the construction of a factory early next year.

C. F. Braun & Co. has just issued a well-illustrated catalogue of about 90 pages describing the auxiliary machinery manufactured by the firm. The first part gives a brief description of the Braun organization and of the plant itself, supplemented by a number of photographs. The second part gives brief descriptions of the principal apparatus manufactured by the firm, including aerators, condensing equipment, cooling-towers, evaporators, expansion-joints, gravity and pressure filters, feed-water and service water-heaters, heat-exchangers, centrifugal pumps, strainers, valves, and water-softeners. The third part comprises photographs of tests of some of this apparatus. Besides this catalogue, the firm also issues special bulletins regarding each kind of apparatus.

The entire attention of **Hamilton & Hansell, Inc.,** will hereafter be devoted to metallurgical and general engineering work. A separate company, the **American Transmarine Co.,** has been incorporated to take over the general export and import business not directly related to engineering. Several Rennerfelt furnaces have recently been sold, including a 1000-lb. furnace for special iron to the A. M. Byers Co., of Pittsburgh, a 300-lb. furnace for aluminum alloys to the Dauch Machine Tool Co., of Springfield, Massachusetts, and two 1000-lb. furnaces for high-speed steel to the U. S. High Speed Steel & Tool Corporation, of Albany, New York.

The Kruse & Banks Shipbuilding Co., of North Bend, Oregon, has purchased from the United States Shipping Board a large part of the equipment and material at the Coos Bay Shipbuilding Co. yard at Marshfield, and will move the same to North Bend. The Kruse & Banks company has two steam-schooners and one sailing vessel under construction. One of the steam-schooners, the 'Anna Hanify', built for the Hanify company of San Francisco, is nearly completed. It will be the first steam-schooner ever constructed on Coos bay fully equipped with machinery and ready to move under its own steam.

The United Engineering Co. has bought the land and building at the north-west corner of Steuart and Folsom streets and is remodeling the structure and installing machinery for the purpose of manufacturing marine Diesel engines. The building is approximately 150 by 150 ft. The company has recently secured the Pacific Coast rights for the Franco Tosi engine, now manufactured in Legano, Italy. If labor conditions permit, the company will be ready to manufacture this engine soon after the first of the year. Besides considerable new machinery the machinery now in the company's shops will be moved to the new plant.

The H. N. Cook Belting Co., 401 Howard street, San Francisco, has issued a very complete catalogue covering its entire line. The booklet is divided into four parts, each printed on a different colored paper, facilitating reference. The 'white section' is devoted to leather belting and, besides giving price lists, describes the various brands handled by the company, and also includes considerable practical and technical information regarding belts. The company's fabric belts, including rubber, balata, camels'-hair, canvas, and cotton, are described in the 'blue section'. The 'yellow section' lists various belt sundries, such as lacing, fasteners, and punches. The 'pink section' describes cup-leathers, packing, and ratchet wrenches.

The McMyler-Interstate Co., of Cleveland, has opened offices in the Merchants Exchange Bdg., San Francisco, in charge of L. A. Somers. The company is a merger of the McMyler Manufacturing Co. and the Interstate Engineering Co. These two companies have for 35 years been manufacturing coal and ore handling machinery, locomotive-cranes, shipbuilding-cranes, car-dumpers, pile-drivers, railroad equipment, and clam-shell, scraper, and orange-peel buckets. The company is now erecting at the Philadelphia Navy Yard an electrically-operated crane with a capacity of 350 gross tons. A special bulletin describing this crane in detail will

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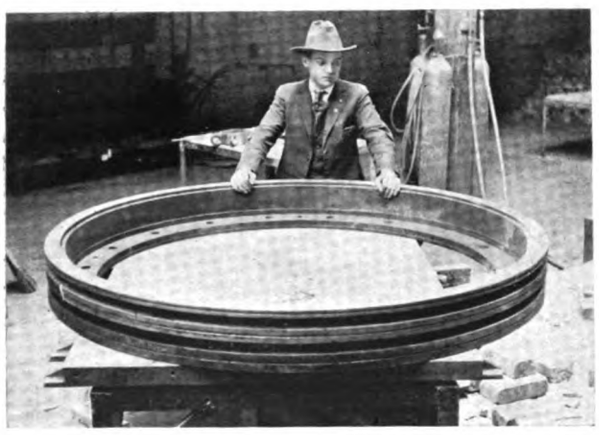
shortly be issued, copies of which may be obtained from the San Francisco office of the company.

The Bristol Co., of Waterbury, Connecticut, has recently issued bulletin No. 279 describing the temperature controllers manufactured by the company. These controllers are based on the principle of the ordinary thermostat, and can be applied to furnaces or ovens heated by oil, gas, or electricity. The controllers are made in several styles for different ranges of temperature. Model 176 is designed for temperatures from $-60°$ to $+150°$F., Model 276 for temperatures from 90° to 500°F., Model 376 for temperatures from 40° to 800°F., and Model 473 for temperatures from 800° to 2000°F., where base-metal thermo-couples are used, and up to 3000°F. where platinum thermo-couples are employed.

'C-H Drum Controllers' is the title of a new four-page two-color 8½ by 11 folder, which has been prepared by **The Cutler-Hammer Mfg. Co.**, Milwaukee. It gives prominence to the outstanding features of C-H drum controllers, which have won for them an enviable position in the drum controller field. Three of the features are: accessibility, interchangeability of parts, and interchangeability of methods of manipulation. Any C-H standard stock drum can be equipped with either rope, radial, or straight line drive and these are interchangeable. The folder plays up other points, such as the ease with which the contact fingers and the cylinders may be removed; the absence of wood in construction; the square metal shafts; and the straight non-stubbing fingers. Dimensions, rating, and other engineering data are given. Three types having common dimensions comprise five bulletin numbers, capable of controlling AC and DC motors from 1 to 100 hp. The folder has been prepared especially for the St. Louis convention of the Association of Iron and Steel Electrical Engineers, but is also being forwarded to those interested in drum controllers.

Brown Brothers Welding Works recently welded a follower-ring 60 in. diameter, using oxy-acetylene, in such an accurate manner that it did not have to be machined before



going back into the engine. The job was welded on a surface-plate, and the finishing was done with a hand electric-grinder. Files were used for finishing the ring-grooves.

Pratt & Whitney Co. has issued catalogue No. 10 'Small Tools and Gauges'. Besides complete data regarding the company's products in these lines, the 358 pages of the catalogue contain a great deal of valuable technical information. At the beginning of the catalogue a strong plea is made for the general adoption of the United States Standard Thread except where special requirements call for the Society of Automobile Engineers Standard, and for the abandonment of the V-thread and similar special types. The tools listed include the regular taps, dies, chasers, milling-cutters, reamers, drills, and also miscellaneous tools. In the division devoted to gauges and standards, several pages are devoted to the company's measuring machines. The difficulty of producing for this machine, not merely a straight bed but one that will stay straight has been satisfactorily solved. The dividing-screw has 25 threads to the inch and 400 divisions in the index-circle, permitting readings to 0.0001 in. These divisions can be further subdivided five times or even more if necessary. A measuring bar has been developed that eliminates the use of end-measures, always a source of inaccuracy. The Hoke precision gauges developed during the War by the U. S. Bureau of Standards and now being manufactured by the Pratt & Whitney Co. are described. These gauge-blocks are kept within 0.000005 in. of marked sizes up to ½ in. and within 0.00001 in. for the longer blocks. They are made for both English and metric measurements. Other gauges of all kinds are described in the catalogue, which also contains tables of pipe-threads and other standards, together with several useful mathematical tables. The catalogue can be obtained from the San Francisco office of the company at 16 Fremont street.

Obituary

Meinrad Humeltenberg, superintendent for the Golden State & Miners Iron Works, died in San Francisco on November 12. He was 71 years old and had been with the company for 59 years, rising from apprentice to superintendent.

George James died November 16 at his home at Seattle. Mr. James was 61 years old. He learned the molder's trade early in life, coming to Seattle in 1889 and establishing the first foundry in the city. From that time he was prominent in the metal trades and in business circles generally in the North-West. At the time of his death he was superintendent of the foundry of the Washington Iron Works.

Market Review

The various strikes that have complicated market conditions during the past few months have now been joined by the coal strike, which, by making freight deliveries from Eastern points still more uncertain, is having a serious effect on the local supply of iron and steel products. In the San Francisco Bay district, the resumption of operations by the shipyards and 'outside shops' has been too recent to have much effect upon the market. Outside of the Bay district the demand is active, and the uncertainty of deliveries is the principal factor limiting sales. The superintendent for one large oil company, for instance, remarked recently that supplies of all kinds are harder to get than at any time during the War. The local price on finished steel products has advanced, and the base now quoted is $4.60 per 100 lb. Eastern prices have advanced considerably, pig-iron being quoted from $3 to $5 per ton higher than during October. Bessemer and open-hearth billets have been selling at $40.50 perton at Pittsburgh, as compared with the price of $38.50 that prevailed during the spring and summer, and some advances are noted in finished products.

The local scrap market is practically unchanged, cast-iron scrap selling for $42.50 and steel scrap for $25.

The local prices of non-ferrous metals at the end of the month were as follows:

Electrolytic copper	20.50
No. 1 red ingot brass	18.50
No. 1 yellow ingot brass	14.50
Electrolytic zinc	10.50
Lead, carloads	7.00
Antimony	9.00

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